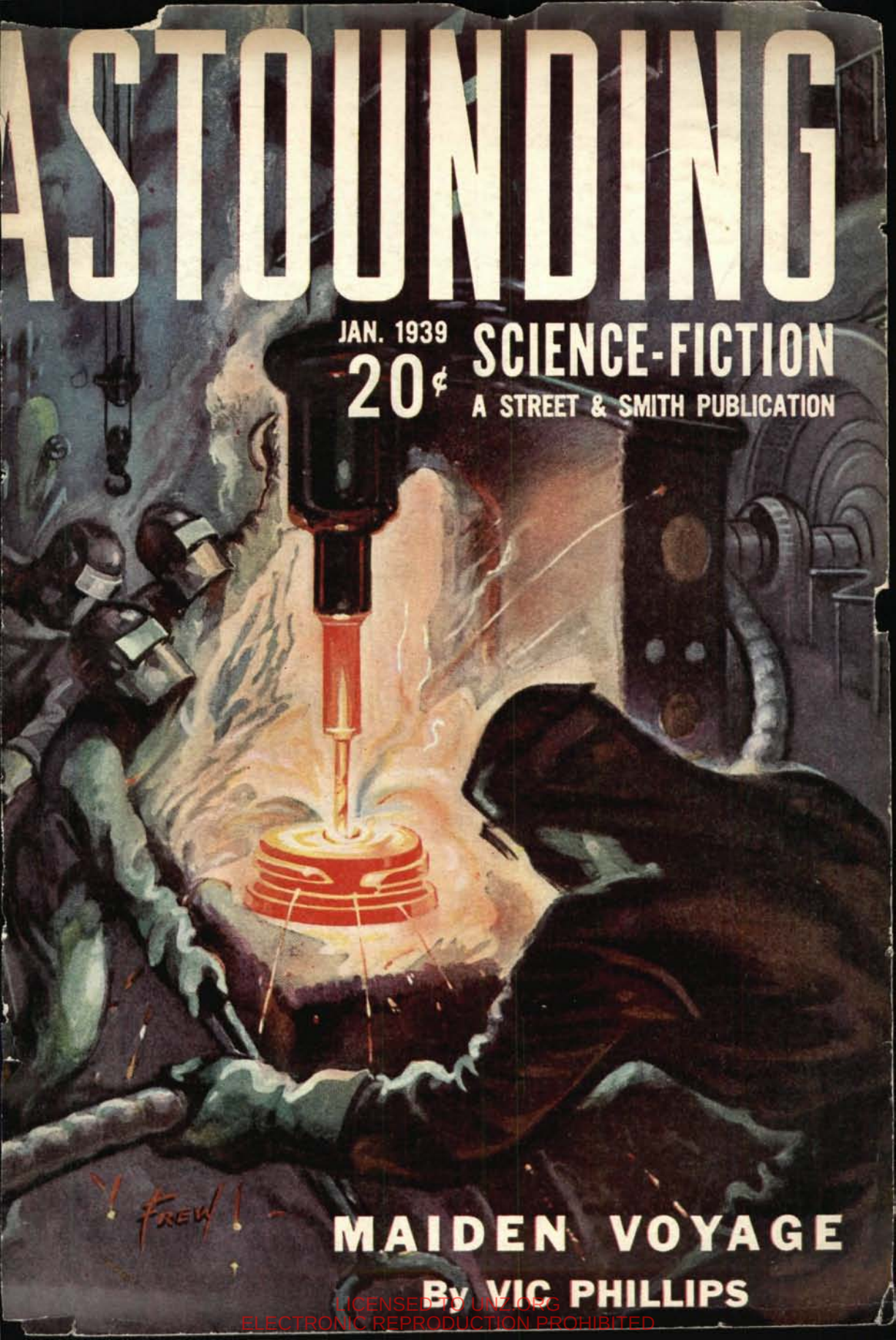


ASTOUNDING



JAN. 1939

20¢

SCIENCE-FICTION

A STREET & SMITH PUBLICATION

MAIDEN VOYAGE

By VIC PHILLIPS

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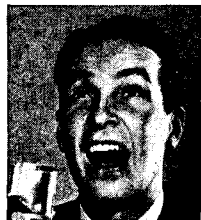
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STREET & SMITH'S SCIENCE-FICTION

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Cover by John Frew. Illustrations by Binder, Dold, Frew, Schneeman and Wesso.

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IN TIMES TO COME

You will notice elsewhere in this issue an indication of an announcement to be made in the February issue of *Astounding*. It will be the subject of next month's Editor's Page, and is unquestionably the most important item in the history of Street & Smith's *Astounding*. It represents a *mutant* in the truest sense, one promising far greater development and import—immensely more—than anything we have yet announced.

But of next month's issue itself. The stories promise well, but that sad, though inevitable foggy of futurity makes it impossible to say just what will be with us. I've said, some months ago, that making up a magazine is somewhat like putting a jig-saw puzzle together. I have the parts of one, plus some of the parts of two more issues. I haven't yet determined which is which, because they're all good parts.

However, Jack Williamson is back. He takes the cover—done, incidentally, by Hubert Rogers, a new man, so comments will be appreciated—with *Crucible of Power*. Williamson's main character is delightfully unique in science-fiction. He's a black-hearted, double-crossing hero, a hero who assays higher in pure brass than in gold—and is the more human thereby!

Also in that issue, Clifford D. Simak, who took tops in the November issue, begins his first serial, *Cosmic Engineers*, involving powers and science to rival even Dr. E. E. Smith's work. In it, too, is a most unusual character—a girl who spent a thousand years in suspended animation, that, due to a partial failure of the untried process, left her nothing to do but think for *ten* *endless centuries!*

THE ANALYTICAL LABORATORY

Since the "fourth Friday of the month" is a somewhat variable date, sometimes the separation between two such dates is less than at other times. So it was this month: the November issue has been on the stands but 10 days as I write. In view of that, I think it would be unfair to list the names of those who spotted the error so soon. The February issue will carry the names—evidently about 100—of accurate spotters. Some few letters spotting the error appear this month in *Brass Tacks*; they are fairly typical of the responses received. There were a number of things that were not wrong, though so called, and a number misinterpreted the yellowish disk of Europa as that of the Sun.

Like Columbus' story of the egg, once the trick is known, spotting the error is easy. However, one gentleman deserves special mention at the moment. Hugo E. Hanser, a consulting engineer, sent me a ten-page analysis of every phase of that picture that was a genuine engineering analysis, with all angular functions worked out carefully. Naturally, he spotted the error.

The Editor sorrowfully confesses a further error, and in this Department, as of last month. Somehow, I brightly remarked that the "shadow of Ganymede has not been seen on Jupiter." Truly, I know better. This Department is written up rather hastily as late as possible to include the maximum of material; that's still no reason for that blunder. The shadow-transits of Jupiter's major satellites are clearly—and interestingly—visible. They appear as very sharp, black holes cruising across the surface of brilliantly luminous Jupiter.

Below, the reader-ratings of the stories of the November issue. Simak's story took a 15% lead over No. 2; that in turn led No. 3 by 12%, with fifth place hotly contested between *Simultaneous Worlds* and *Return of the Prowler*.

One reader suggested that serials were unfairly handicapped in their ratings by the fact that many readers wait to read the entire story when the conclusion is available. Note, however, that both serials were strong enough to place despite this—and in an issue generally rated "very good."

1. Reunion on Ganymede
2. Seaward!
3. Who Was Dilmo Denin?
4. The Tramp
5. Simultaneous Worlds

Clifford D. Simak
Malcolm Jameson
Ross Rocklynne
L. Ron Hubbard
Nat Schachner

A VARIETY OF THINGS

Recently, at the Philadelphia Science-Fiction Convention, a number of fans and other science-fictionists were asked to give their views on the purpose of the subject. I only regret that it might have come a bit later. Then, I believe, we might have recognized in science-fiction's spread a means of teaching those members of the American Public with an excess of imagination with respect to radio dramas, and a lack of understanding of things interplanetary, just what chances the Martian Invaders would have.

Incidentally, I have long been an exponent of the belief that, should interplanetary visitors actually arrive, no one could possibly convince the public of the fact. These stories wherein the fact is suddenly announced and widespread panic immediately ensues have always seemed to me highly improbable, simply because the average man did not seem ready to visualize and believe such a statement.

Undoubtedly, Mr. Orson Welles felt the same way.

As has been demonstrated, that belief was wrong. Perhaps, if it be more than an incident "full of noise, signifying nothing", it signifies a need for wider appreciation of science-fiction?

We've had one example of science-fiction coming true—the country alarmed by an invasion of Martians—and the editor of our companion magazine, *Air Trails*, has pointed out another item of "fantastic fiction" now become fact. Back around 1930, science-fiction was given to describing some remarkable airplanes. Stratosphere planes that controlled themselves, finding their own way across the country, finding their airport destination, settling, and landing on a given spot of that airport automatically. These planes were to have altimeters using radio-reflection from the ground below to give them actual clearance altitude instead of sea-level elevations. By adaptation of the same principle, they were to avoid each other. Directional radio was to lead them and bring them to a landing.

The radio-reflection altimeter has been developed now, of course. It gives above-ground elevation direct in feet, detecting even upreaching objects such as high bridges or buildings. It almost certainly can be directed horizontally to detect and avoid other planes. It can be integrated with the preexistent automatic pilot to automatically control the plane. In addition, the new radio compass that points automatically and continuously to whatever station has been tuned in, can be used to guide the plane. The U. S. army has developed a completely automatic blind-landing system that, by means of radio, will bring a plane down on a selected spot of an airport.

That, too, may be improved by another interesting gadget. The Bell Laboratories and M. I. T., simultaneously and independently, discovered a way of sending ultra-short radio waves through a pipe. Amusingly, the best and cheapest commercial item for this work is a rain spout. But a piece of flexible metal hose serves nicely, and, since the radio waves can be made to jet out of the open end of the pipe in a self-restricting pencil, a metal hose can be used to squirt radio around in desired directions. So sharply does the projected energy hold to that original diameter and direction, hitherto impossible directional fineness is possible. It should, in fact, improve still more the blind-landing system already developed.

Incidentally, it represents the interesting picture of energy being sent through a nonconductor wrapped up in a conductor, instead of the more familiar energy down a metallic conductor wrapped in nonconducting air or rubber.

The Editor.

HE THOUGHT HE WAS LICKED--THEN A TIP GOT BILL A GOOD JOB!

MY RAISE DIDN'T COME THROUGH MARY--I MIGHT AS WELL GIVE UP. IT ALL LOOKS SO HOPELESS.



IT ISN'T HOPELESS EITHER, BILL. WHY DON'T YOU TRY A NEW FIELD LIKE RADIO?

TOM GREEN WENT INTO RADIO AND HE'S MAKING GOOD MONEY, TOO. I'LL SEE HIM RIGHT AWAY.



BILL, JUST MAILING THAT COUPON GAVE ME A QUICK START TO SUCCESS IN RADIO. MAIL THIS ONE TONIGHT



TOM'S RIGHT--AN UNTRAINED MAN HASN'T A CHANCE, I'M GOING TO TRAIN FOR RADIO TOO. IT'S TODAY'S FIELD OF GOOD PAY OPPORTUNITIES



TRAINING FOR RADIO IS EASY AND I'M GETTING ALONG FAST--

SOON I CAN GET A JOB SERVICING SETS--

OR INSTALLING LOUD SPEAKER SYSTEMS

THERE'S NO END TO THE GOOD JOBS FOR THE TRAINED RADIO MAN



YOU SURE KNOW RADIO--MY SET NEVER SOUNDED BETTER

THAT'S \$15 I'VE MADE THIS WEEK IN SPARE TIME

THANKS!



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OH BILL, IT'S WONDERFUL. YOU'VE GONE AHEAD SO FAST IN RADIO.



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Find Out What Radio Offers You

Act Today. Mail the coupon now for "Rich Rewards in Radio." It's free to any fellow over 16 years old. It points out Radio's spare time and full time opportunities and those coming in Television; tells about my training in Radio and Television; shows you letters from men I trained, telling what they are doing and earning. Find out what Radio offers YOU! MAIL COUPON in an envelope, or paste on a postcard--NOW!

J. E. SMITH, President, Dept. 8ND
National Radio Institute, Washington, D. C.

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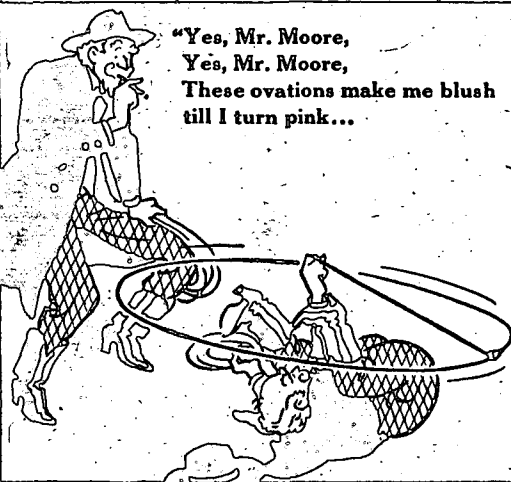
"Oh, Mr. Mattingly,
Oh, Mr. Mattingly,
How can we retain our
native modesty..."



"When folks holler from the
tree-tops:
'M & M is really THE tops
For its mellow flavor
and its quality!'"



"Yes, Mr. Moore,
Yes, Mr. Moore,
These ovations make me blush
till I turn pink..."



"And the reason,—er—ahem—is
That our whiskey, M & M, is
Slow-distilled for glorious goodness,
yet priced lower than you'd think!"



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fine, mellow, slow-distilled whis-
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of straight whiskies...the kind of

whiskey we believe is *tops!*

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The Blue-men Of Yrano



A new novelette by

Warner Van Lorne

WHEN strange vibration began to shake the plane Martin searched frantically for some explanation. It felt as if the motor had torn loose, yet everything seemed perfectly normal.

He glanced at the ground, six thousand feet below, but the mountains were

unbroken in every direction. A faint haze made them seem unreal, and he shook his head to clear his eyes. When he looked again the mist had thickened.

Vague images appeared on wisps of cloud, and twice he almost turned the ship aside to avoid mammoth trees. They must be reflections of the forest

beneath, yet so realistic that cold sweat dripped from his face as the plane passed through.

The vibration increased as his eyes searched hopelessly for a place to land, while the ground seemed to waver and fade in the thickening haze.

The instruments all registered properly, but during the instant his eyes were on the gauges the vibration ceased as suddenly as it had started.

As he glanced front again his fingers froze to the controls! *The tree images had become reality! The mountains had disappeared!*

The plane was flying in a forest—with two huge tree trunks directly ahead! The tip of one wing touched and whirled the ship around. It was the last that Conway remembered.

A PUZZLED frown spread over his features as he examined the design on the ceiling. Each of the scenes within his vision depicted the same people. Blue-skinned men—with the same color in hair and mustaches!

Their long faces were perfectly pictured, while vaguely recognizable human forms cowered before them. In some scenes, people were almost groveling on the ground before their blue masters. In others, they gazed into the blue faces in abject terror.

The scenes were almost burlesqued, and Martin started to laugh; then his face straightened.

A blue face was only a few inches above his own, and slowly coming closer, to gaze into his eyes! A second and third face appeared.

An uneasy feeling crept over him. All three men had strange purple eyes from which emanated a strange glint. For a long time no one moved, while the three men peered steadily into his face.

Suddenly Martin rolled off the far side of the couch! The men acted insane!

As he backed across the room, they followed around the end of the low bed, still glaring into his eyes. When his back touched the wall they formed a half circle, their faces only a foot from his own.

One of the men suddenly turned away, screamed and tore his hair in rage. A moment later all three men were stamping around the room in anger. For the first time in his life, Martin knew fear. The blue-men *were* insane—and he faced three of them!

When one of them shouted, two more blue-men came running into the room, and jerked Conway to his feet. Then he was hurried through the door into a wide hall.

Gleaming stone walls, on both sides, were broken occasionally by doorways. Through the openings Martin saw blue-men on couches similar to the one on which he had awakened. In each instance the men were injured, giving the impression that the building must be a hospital.

Every blue-man they passed stopped to laugh in a high-pitched voice, while many of them constantly fingered their small mustaches, as if in great pride. They acted as if he were a man of lower order. Martin wished he could drive his fist into their finely chiseled features.

The men all dressed alike, in loose-fitting pantaloons, and flowing white blouses which hung to their hips. The guards wore the same garments with the addition of metallic harness over their shoulders, and strapped tight around the waist. Bright red embroidery made their occupation unmistakable; it depicted prisoners, led by chains around their necks.

Peculiar weapons hung on each side of the guards' heavy belts. A small rod, nine inches long, protruded from the edge of a disk six inches in diameter. The circle of metal was curved on one surface, a hand grip on the other. The

weapons appeared terribly heavy to carry for any length of time.

When a blue-woman, dressed in a plain white robe, stepped from one of the doorways, Conway struggled desperately to break away from the guards—they had forgotten to give him any clothes! But the men held him helplessly, much to her amusement.

He felt weak and sick from the exertion, and discovered that his body was covered with freshly healed wounds. His physical condition had been forgotten in the excitement of awakening in the strange place, but now his knees tended to buckle beneath his weight.

AT THE END of the long hall the guards pushed him into the covered opening at the top of a flight of enormous stairs. The steps were eighteen inches high, with another doorway at the bottom of the twentieth. One guard sat on the steps beside Conway, while the other remained near the upper entrance.

They began to move. The whole metal-inclosed stairway was traveling down a sloping rail, the "steps" used as seats while the car was traveling. Through openings in the lower door Martin could see the track ahead for several stories.

When they came to a stop, the lower doorway opened directly upon a wide avenue, crowded with people. Once more Conway tried to break away, but was marched through the pedestrian traffic without consideration for his nakedness. Laughter came from many of the passing throng at his appearance.

His anger mounted as he was dragged naked along the street. This race of blue-men might be slightly off in their minds, but they were the most conceited beings imaginable, and seemed to draw away from him as if they would be contaminated by contact.

Martin had been so angry at his treatment that he had seen nothing of the surroundings. When his eyes ran up

the facade of the nearest building he stopped in amazement. It tilted backward! Then other buildings registered in his sight, with the same slanting front.

Windows were set flush with the sloping wall, adding to the illusion that the structures leaned back. For a moment, Conway expected to see them topple over, then the significance of their construction became apparent.

Structures sixty and seventy stories high allowed almost as much light to reach the street as would in open country. The slanted windows also allowed light to penetrate to the interior in greater intensity.

Soft sand covered the surface of the road, and Martin noticed that the blue people all had bare feet. The cross streets had the same soft surface, which was easy to walk on.

This avenue was used by pedestrians only, like a promenade where people apparently walked for pleasure. The streets behind the large buildings carried all commerce.

Women as well as men tripped along the street, immaculately dressed. Beautiful store fronts attracted the passing throng with gaudy displays. In every window the main color was blue, as if they never tired of it.

Women turned to laugh at Martin's discomfort until he gradually became immune to their stares. His embarrassment disappeared, to be replaced by burning hatred of this conceit which reached the point of insanity. They seemed to resent the fact that he didn't cower at their glance, and twice men tried to hit him as they passed. The guards jerked him away before they succeeded, then laughed at the interruption. Conway stumbled many times from weakness, but his captors kept him on his feet.

When a commotion in the road ahead drew his attention, the guards stopped where he had a clear view.

Two naked forms were dragged from

one of the buildings and dropped in the center of the avenue. Martin thought they were dead until one of them rolled over to turn his face away from the sand. He was too weak to rise from the ground, but lay with his eyes to the sky.

Suddenly a passing blue-man kicked the helpless man in the side. Others followed until the two wretches moaned and quivered in agony.

Martin fought desperately to reach them, but the guards laughed at his struggles. From fifty feet away the groans of the two emaciated beings reached his ears plainly.

But—they were white!

CONWAY began to understand. These were the first people of his own kind that he had seen since awakening—and they lay in the road for every passer-by to kick. Helpless physical wrecks, emaciated and filthy. So dirty that recognition as white men came only after several minutes of watching.

He felt sick. People of his own kind, treated worse than animals by a race of supercilious blue-men. Tortured and maimed for insane entertainment. In that moment Conway swore to be avenged on this race—if he lived.

The guards that had thrown the men into the road, dragged the unconscious forms back through the same doorway. Martin sighed in relief to see the blue-men tire of the torture, and remove the victims.

His own guards marched him into the building, a few feet behind the others, and stopped just inside the door of the first room. The unconscious white men lay in the center of the floor, while a blue-man looked down at them from his perch on a stool in one corner. The guards were speaking, and accompanying their words with demonstration.

As they appeared to stumble over the prone forms, an understanding of their actions seeped into Martin's mind. He

was almost blind with rage as the proceedings continued. The inconvenience to the passing throng—*was a crime*. The helpless men were being charged with obstructing traffic!

When the man on the stool waved his arm, the prisoners were dragged from the room. Then Martin was moved forward. A puzzled expression appeared on the blue-man's face as he addressed Conway in a queer high-pitched voice.

When Martin spoke in English, the insane face darkened with anger. Leaping from the high seat, he planted a kick in Conway's stomach that doubled him over in agony.

Twice more the prisoner was jerked erect, and addressed. Twice more he replied in English, and received a kick each time. It was more than Martin could stand, and when he slumped in feigned unconsciousness the guards let him fall to the floor. Then he was dragged through the door where the other prisoners had disappeared.

The shrill laughter and unearthly cackling of blue-men grew plainer as they advanced. The passage ended at an arena one hundred and fifty feet in diameter, with smooth circular walls. At intervals, large cages rested on the stone floor, each on a heavy cable reaching to the ceiling far above. The babble of sound came from the top of the room.

When Martin was locked in the nearest cage, it started rising. There were thirty-six cages, and his made the twenty-fourth that was drawn up from the floor.

As his eyes turned to the babble of sound above, he saw human arms reaching through the wires of the cages. The prisoners were pleading—screaming—

The odd prison cells swayed on their heavy cables, a few feet below the ceiling. At the same level were openings in the smooth wall of the arena, where spectators watched the caged exhibits from a recessed passage.

Some of the naked wretches sang and danced. Some of them did acrobatics. But all of them pleaded for bits of food from the audience. When one of the prisoners pleased the onlookers, he received a crust of bread in payment.

Only three of the cages were silent. Two of them contained the prisoners who had been thrown into the road while Martin watched. The other one hung next to his own, the occupant crouched in one corner. Conway was glad the cages, containing the emaciated forms of the tortured men, were on the far side of the room.

WHEN HIS CELL was drawn within a few feet of the ceiling, the cable automatically locked, suspending it about fifteen feet from an opening to the recessed passage.

The cages were constructed of heavy wire, with a solid plank floor six feet square. A small wooden bench was the only furnishing. The wire strands were not heavy enough to hold a husky man, but it was fully a hundred feet from the cells to the floor of the arena.

A crowd soon gathered to watch the new prisoner. At sight of the blue faces, Martin's anger mounted until he wanted to tear the cage apart. He was weak from wounds and the exertion of the past two hours, but anger seemed to give him strength as the people offered bread crusts for entertainment.

He finally approached the wires of the cage, and started making faces. When he imitated their facial expressions and walked back and forth mimicking their supercilious airs, the blue-men screamed in hysterical frenzy. Each time he made a face which resembled one of them, the men almost jumped off the gallery in excitement. Martin had found a way to entertain himself!

Suddenly a metal decoration from one of the women's flowing robes, sailed through the air into the cage. They began to throw anything within reach.

Crusts of bread were flung until he had to duck to avoid being hit. Each time the barrage stopped he made faces, until the floor of the cage was half covered with the food-intended to bait the prisoners. He had unwittingly obtained enough to last several days.

The blue-men were frantic. Instead of baiting the prisoner, he was making fools of them. They screamed and tore their hair, until the building shook. Other prisoners copied Martin's actions until the room became a bedlam of screaming blue-men. Finally the guards cleared the spectators from the building to keep them from trying to get at the prisoners. But every caged white man had enough to eat! Blue maniacs had thrown every bit of food they brought.

As the people were removed from the balcony, Martin heard the tinkle of a laugh and swung toward the cage beside his own. He stared in amazement. A woman crouched in the darkest corner!

It was bad enough to display male prisoners as animals, but this woman was being given identical treatment.

She was young and dark, and quite attractive. She held a small piece of cloth before her, trying to hide her nudity. That was greater torture than if she had been given nothing.

When Martin looked away his knuckles were white where he gripped the wires of the cage. She smiled slightly, yet seemed more embarrassed than she had under the gaze of the blue people. He tossed her several pieces of bread, as she had received none of the barrage of food. The remainder was stacked beneath the bench, where there was little chance of the guards discovering it.

When the last of the spectators had gone the cages were lowered to the floor of the arena one at a time. The guards handed each occupants a cup of water and crust of bread; twenty-four hours' rations.

II.

GRADUALLY, in the silence during the night period, a sort of provisional picture of the situation built up in Martin's mind. Somehow—that vibration in his plane, perhaps—he had been transported to a different world. Here, the blue-men were the rulers, a race that must be, since they had control, brilliant. But their minds were hysteric, unstable. Normally, seemingly, they were ego-maniacs of a queer, not-quite-insane type. But that delicate, unstable balance of their minds was unpredictable.

Partly, that mastery over these white prisoners must be necessary to them—an outlet for overweening ego. That they should taunt the prisoners, display them in this degrading way, stimulated and pleased the blue-men's ego. But that the prisoners should, instead of begging, pleading, and attempting to please with dances, mock and mimic their mighty captors—! It maddened them, made violently hysteric madmen of them.

That such unstable minds could rule and maintain themselves seemed strange, almost impossible. The whites he'd seen so far seemed normal, though these were strange specimens by which to judge. Were the whites so few as to be helpless, or was it that those near-insane blue-men had, none the less, real genius? Genius was said to be near insanity; perhaps this whole race represented just such a condition.

Well, for tonight, he must rest and sleep. The ache of his muscles grew acute, and he was still weak. Rest and observe and learn; then, when he knew more, he would be in a position to act.

The blue people paid no attention to the antics of the captives the following day. They had evidently been warned about the strange actions. Finally, the prisoners started singing and dancing again to obtain the small morsels. Conway had been the only one to receive any quantity of the food.

If it had not been for the food that was thrown, he could never have regained his strength. The amount they were issued was not sufficient to keep a human being alive, and they either slowly starved to death or begged enough to exist.

With each succeeding day Martin's hatred of the blue-men increased. The treatment of the prisoners made animals of them—and they were all white! The blue-men did not subject their own race to the humiliating cage system.

There were two men in some of the cages, and they always attracted the largest crowd. When a crust of bread was thrown, the inmates fought until one was down. Conway saw two of the wretches fight until both were so badly beaten they could not eat the food they had been fighting over.

Martin examined every inch of the prison as his strength slowly returned. He wasn't going to stay if there was the slightest chance of escape. The human misery and the attempt to make beasts of the men kept his nerves on edge. Several times he almost screamed at the shrill sound of the blue-men's laughter.

The drop to the floor of the arena eliminated escape in that direction, and too many well-armed guards watched when the cage was lowered. There was a chance where the cable ran across the ceiling to disappear in the wall above the passage, and he intended to take it. Each day he tested his strength, until he felt satisfied.

As soon as the last visitor had gone Conway went to work. When the wires of his cage gave enough to squeeze through, he climbed to the outside. The girl in the next cell watched breathlessly as he leaped the six feet to the side of her prison.

He was thankful the cage on the opposite side of his rested on the floor beneath. The other prisoners would grasp any chance of release, after a few weeks of torture. If they gave an alarm, it might

result in freedom for the spy.

The upper lights were turned out after the cages had been lowered for the bread and water. Only a dim glow came from lights on the floor beneath. His actions could not be seen from the more distant cages, and the form of the girl was hardly visible until he gripped her cage. Then he spent a terrible half-hour forcing the wires apart, while clinging to the outside.

As he dropped to the floor beside her, he pointed along the overhead cable. He could only make his thoughts known by motions. One of the openings to the sightseeing gallery was only six feet from the spot where her cable entered the stone work.

She had never seen such daring as this stranger displayed, and what he contemplated seemed utterly impossible. But life in the cage was horrible enough so she was willing to die in the attempt to reach freedom.

As she slid her emaciated body through the wires, to hang one hundred feet above the floor, her arms shook violently. Martin quickly climbed through to steady her, but even then her fingers had started to slip. They clambered to the top of the cage where there was a slight feeling of security.

When her quaking had stopped, he pointed along the cable. Placing her fingers solidly around the taut strand, she swung out over space. As she edged slowly along, he moved inch by inch behind her. Twice she almost lost her grip, and he helped her to obtain another.

THE FIFTEEN feet seemed like five hundred as they swung through the darkness. When her form finally touched the stone wall she almost let go.

Sweat poured from Martin. He couldn't see where they were going, or locate the opening to the gallery, but knew it was six feet to the side, and slightly below. As he thought of it in

the darkness it seemed a very small opening to strike.

When he wrapped his legs around her, she let go of the cable. His arms seemed ready to pull from their sockets, as both weights were suspended by his fingers. Twice he swung back and forth to swing her to the opening in the wall, but she didn't let go when he released the hold with his legs.

Once more he swung back and forth, until they had sufficient momentum. This time her fingers slipped away. His heart stood still for an instant, but the thump of her weight striking the floor of the gallery came as sudden reassurance. In the fraction of a second it had taken to swing across the space he imagined her falling halfway to the stone floor beneath.

His arms seemed to grow numb, and he tried desperately, vainly, to swing back and forth. He could not hold on for long, but must make the attempt without obtaining momentum. His fingers slipped away from the cable, he felt himself heading toward the floor beneath—then the stone rail hit him in the side!

He scrambled desperately, his fingers slipping. His numbed arms were inside, but his legs and body hung over the arena. He was slipping back toward eternity!

Suddenly an arm reached out of the darkness to help him scramble over the top. He fell exhausted on the inside, the girl half-crumpled across him.

When Martin caught his breath, he swung the girl across his shoulder, without waiting for her to regain consciousness. With each passing step her body seemed heavier. Twice he stumbled and almost fell before they reached a passage away from the gallery. There had been no sound from the cages and he hoped their escape had been unnoticed.

Lack of water during the three weeks of imprisonment had been torture, but

he felt the lack more than ever from the effort of carrying the girl. He glanced at every dark spot in search of a drinking fountain, and was at last rewarded in a side passage. A moment later he was pouring water over the girl's face. She soon joined him in the first satisfying drink since they had been in prison.

Hours passed while they groped through the dark. Statues that loomed directly ahead seemed living, menacing guards. The prisoners, seemingly, were only one of the "attractions" of the mammoth structure; it was also a museum.

Twice they passed the curious elevator cars that traveled down at an angle, but dared not use them. The hum of the motors might call the attention of the guards. Martin knew there must be a stairway, but it seemed impossible to locate. With each passing hour their chances of escape lessened. It was too big a city to cross during daylight, and the prison building was near the center of the metropolis.

They felt along each shadowy wall, but the surfaces were unbroken. When they entered one of the outside rooms, dim light penetrated through the sloping windows. Martin had been afraid the night had passed during their search, but the stars were still shining.

But there was a door in the wall of the room! It was the first sign of break in the stone surfaces. They had been searching the interior rooms as the most likely place for a stairway, but apparently these people built stairways near the outside of the building, more as emergency exits. Beyond the door, dust-covered stairs led down. It had been years since a human foot touched their surface.

MARTIN TRIED each step carefully; while the girl clung to his fingers in the utter blackness. Down one story, the stairs ended in a passage five feet

wide. They felt along each wall as they moved forward.

When they made three turns, and crossed two other passages without finding stairs, a hopeless feeling came over Martin. Their attempt at escape was balked before it had hardly started. He began to walk faster, running his fingers along the surface almost fast enough to burn them from friction.

The girl tried to hold back, but he dragged her along in desperation. It seemed they must have circled the entire building. Then suddenly the ground seemed to fall away beneath Martin's feet! He let go of the girl's hand to catch his balance—and dove headfirst down stone steps!

He seemed to bounce along the treads, as everything faded into silence. Even the girl's scream seemed to come from miles away.

His head was pillowed in her lap when his eyes opened. For a moment he couldn't think where he was, but the ache in his head brought everything back. No bones seemed broken, although every movement was agony.

When he got to his feet the girl had to steady him. He couldn't go on until his brain cleared, and finally lay down to ease the pain. It seemed that many hours had passed while he lay unconscious, but the girl's unknown language could tell him nothing.

Something warm touched his face, and he reached up and felt of her cheeks before she could turn away. They were wet with tears! He fell asleep while the girl stroked his forehead.

She was shaking his shoulders. Voices came from the head of the stairs where he had fallen. They had left plain tracks in the deep dust of the passage, and the blue-men were following.

There was no time to lose. Lights shone along the upper passage, and the blue-men would reach them before many moments. After being in the dark for so long, their eyes picked out the pas-

sage easily from the dim glow that reflected along the stone work. They ran until the last glimmer faded.

Once more they joined hands and felt along the walls, hurrying as fast as possible, while testing each step to make sure the passage didn't end in another stairway. The tunnel had sloped down from the time they first entered, and Martin hoped they were near the street level.

Suddenly his fingers encountered a door, and he opened it carefully. Light from distant windows dispelled a little of the gloom, but objects were only dimly outlined. It appeared to be an unused room, where huge animal statues were stored. The floor was free of dust, and they couldn't be followed by their tracks.

The searching blue-men would soon enter the room, and he hunted frantically for some hiding place. As they passed beneath one of the giant statues, he noticed a crack in the undersurface of its belly. A moment later he was clambering up the hind leg to investigate.

It proved to be a trapdoor, leading to the hollow interior of the huge casting. From his shoulders the girl's fingers reached the edge of the opening, and he pushed her feet up until she pulled herself through the trap.

Once more he climbed up the leg. He turned and raised himself to the inside, as the blue guards entered the room. He lifted the trap into place silently, and the animal appeared as it had before.

For an hour they dared not move. The sound of voices came clearly through the metal of their hiding place. Only when the sound faded away did Martin dare to open the trap. They had almost choked from dust, and lack of ventilation. Twice Martin had grabbed the girl and pressed her upper lip as she started to sneeze.

More men came into the room and searched every corner, but they did not examine the metal animals. When several hours passed without sign of blue-men, Martin felt easier.

THE DISTANT windows were dark when he climbed from the hiding place, and helped the girl to the floor. It had been twenty-four hours since they escaped from the cages—and they were still in the building! He hoped the search had been given up, but the museum would have a stronger guard.

There were many doors in the walls now, and they tried each one carefully. When one opened on a passage, Martin jumped back. Three guards were only a short distance away, a prisoner held between two of them. Conway recognized the passage from the guard room to the arena. They were on the ground level—the street only a short distance ahead!

But Martin's nose had discovered something equally interesting—the odor of food! It had been so long since he had tasted anything but dry bread that the aroma almost made him dizzy. When the guards disappeared toward the arena he stepped out carefully, motioning the girl to wait.

The smell of food came from a room directly opposite, where a meal awaited three men. The guards had evidently been called from their dinner to take the prisoner to his cage. When they returned every dish and cup had disappeared; Martin cleared their table completely, convinced that he and the girl could eat the food intended for all three men.

It required four trips across the passage to carry everything to the room where the girl waited. When he returned the last time she was setting their dinner on a wide bench. Before joining her, Martin slid a heavy bolt on the door.

He never remembered tasting anything so delicious as that meal. The fact that it was stolen from blue guards made it taste even more savory.

When the robbery was discovered they heard the shouting in the passage, but the guards didn't dream they had

been robbed by their own prisoners and rushed toward the outside of the building.

The meal made the two sleepy, and they stretched out on couches. They were in a section of the museum that was used daily, but had been closed for the night. Conway knew it was safer to stay awake, but his eyes closed in spite of every effort. It was the first comfortable bed he had known in the blue city.

When he awakened the girl was watching from a chair a few feet away. He had begun to be interested in eating again, and knew it was several hours since they had stolen the meal.

Everything was silent as he slowly opened the door to the passage. Creeping to the guard room, he peered around the edge of the doorway. One man sat with his back toward Martin, while four more were asleep in bunks in an adjoining room. The man had evidently been left on guard, and was resting for a few minutes.

The only exit that Martin knew of was through that room, and they dared not try to slip past the sleeping men. He crept forward inch by inch, while the guard nodded on a hard bench. His back was against a table in the center of the room, a heavy paper weight a few inches away.

Suddenly Martin's arm raised, the weight in his fingers. When it descended the blue-man slumped in peaceful rest. An instant later Conway was in the room with the other guards, and called on them one at a time. When he left they had stopped dreaming, a lump the size of an egg on each head. Conway glanced through another doorway—and hesitated.

The officer who had kicked him in the stomach was asleep in there, and he grasped the weight more firmly. When he too had joined the others in deep slumber, from which they would not

easily arouse, a smile spread over Martin's face.

It only required a moment to throw the form of the blue officer across his shoulder, and head down the passageway. Five minutes later he was dressed in the officer's uniform and the blue-man was naked.

III.

HE FOUND the girl dressed in a guard's uniform several sizes too big. While he had been away she had gone looking for him, and described the lumps she had seen on the guards heads by hitting her own. As they passed through the room where the men lay unconscious, she pointed at an empty hook on the wall, then to her own clothing. Her description in motion made Martin smile. But she was dressed completely, including the heavy gun at her side.

As she tried to hide a smile, it puzzled him. She seemed to want to laugh, and he glanced around in search of the answer. Suddenly his eyes stopped on one of the blue-men, then he burst into smothered laughter. The girl had entertained herself by ruining their great pride and joy—half, but only half, of each man's flowing mustache was missing.

The sky was growing lighter as they stepped out of the building. A few early risers were already on the street, and twice they faced store windows while someone passed within a few feet. The girl led the way down small side streets when Martin seemed undecided. These were covered with sand the same as the main avenue, except for two metal rails in the center. Heavy material appeared to be moved on the tracks, while smaller loads were carried by hand.

Martin gripped the heavy weapon at his side, as a blue-man approached them directly. The man thought that two guards were peering into the store window when he tapped the girl on the shoulder. Before he had time to speak,

the heavy weapon landed on his head. A moment later his form slid into an open cellarway.

It was daylight when they turned into the entrance of a large building and dodged into a narrow side passage. Conway became puzzled when they climbed story after story by little-used stairways, panting for breath before the trip was half completed. They were forced to hide several times while blue-men passed, and he wondered where she could possibly find a hiding place in such a busy structure.

When they reached the flat roof, forty-five stories above the ground, he began to understand. The girl led the way toward a row of queerly shaped objects. The long, narrow hulls, with round windows along both sides, gave the impression of a fleet of submarines. But they were on the roof of a building. Narrow fins ran the length of the strange craft, protruding several feet from the curved sides. Polished metal gleamed in the early morning light. As they approached the slimmest craft in sight, Martin saw hundreds of tiny propellers dotting the surface of the fins.

The cigar-shaped objects were airships. They must fly to be kept on the roof of the building. The hundreds of small propellers were on the surface of rudimentary wings, which he had mistaken for fins, and appeared to control every action of the ship. There were no rudders or other sign of guiding equipment.

The girl opened a small port and he followed her into a large forward cabin. Upholstered seats for twelve people and a chair before the control board filled the space completely.

The equipment was more intricate than he had seen on even the largest airliners. The girl seemed puzzled as he examined the controls in amazement. After a moment she sat down in the pilot chair and slowly swung the ship around to face an open track across the thou-

sand-foot roof.

Martin had wondered about a heavy metal runner beneath the hull, but now he understood its action. Instead of rolling on wheels, the ship slid along the surface. A slight hum was the only sound, as the sixty-foot hull turned on the polished metal. When it faced to the girl's satisfaction it started smoothly forward, as if pushed by an unseen hand.

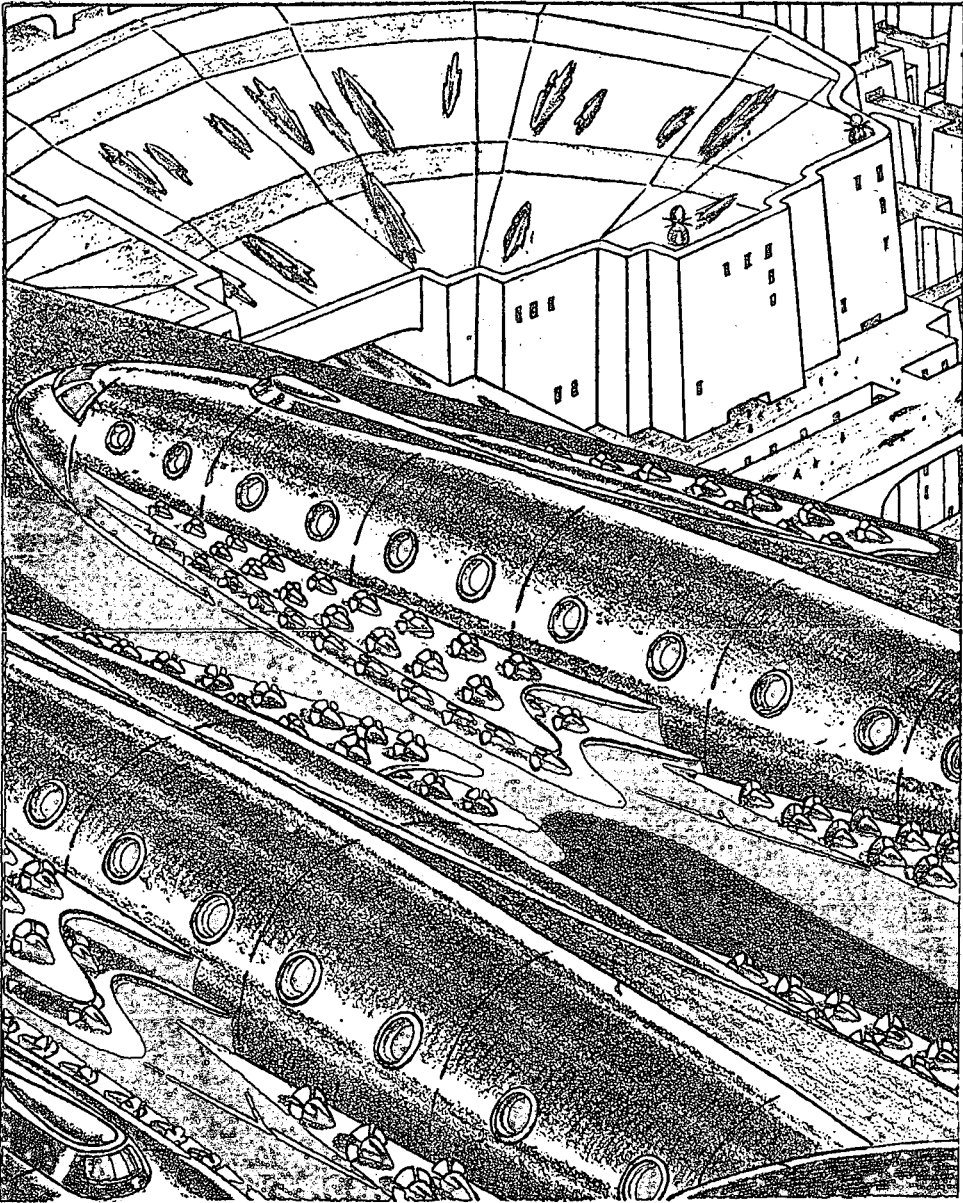
Conway heard no motor; the ship moved smoothly without sign or sound of power. Every action was controlled by buttons on the huge board, and he watched her fingers as they touched each one. Before the ship had gone a hundred feet, it had obtained terrific momentum. When it reached the edge of the roof, it soared into the air at the touch of a small lever.

IN TWO MINUTES the city of blue-men was behind, and they were heading toward a distant range of hills. The ship cut through the air faster than Martin had ever flown. When the girl turned away from the control board the ship followed the course automatically. Sight of three pursuing ships sent her hurrying to the controls, and the craft leaped forward with a new surge of power.

From her swift sign-language explanations he gathered that the ship was electrically powered. Electric development far surpassed anything Conway had ever known.

Soon he understood why the girl picked the slimmest ship on the landing roof. It was much faster than the pursuing craft and soon outdistanced them. From the fine interior equipment it appeared to belong to some wealthy man, and was built for speed and comfort. The controls in the main cabin gave the impression of owner operation.

A small passage led from the back of the cabin through the center of the twelve-foot hull. The cabin was twenty feet long, the remaining forty feet of

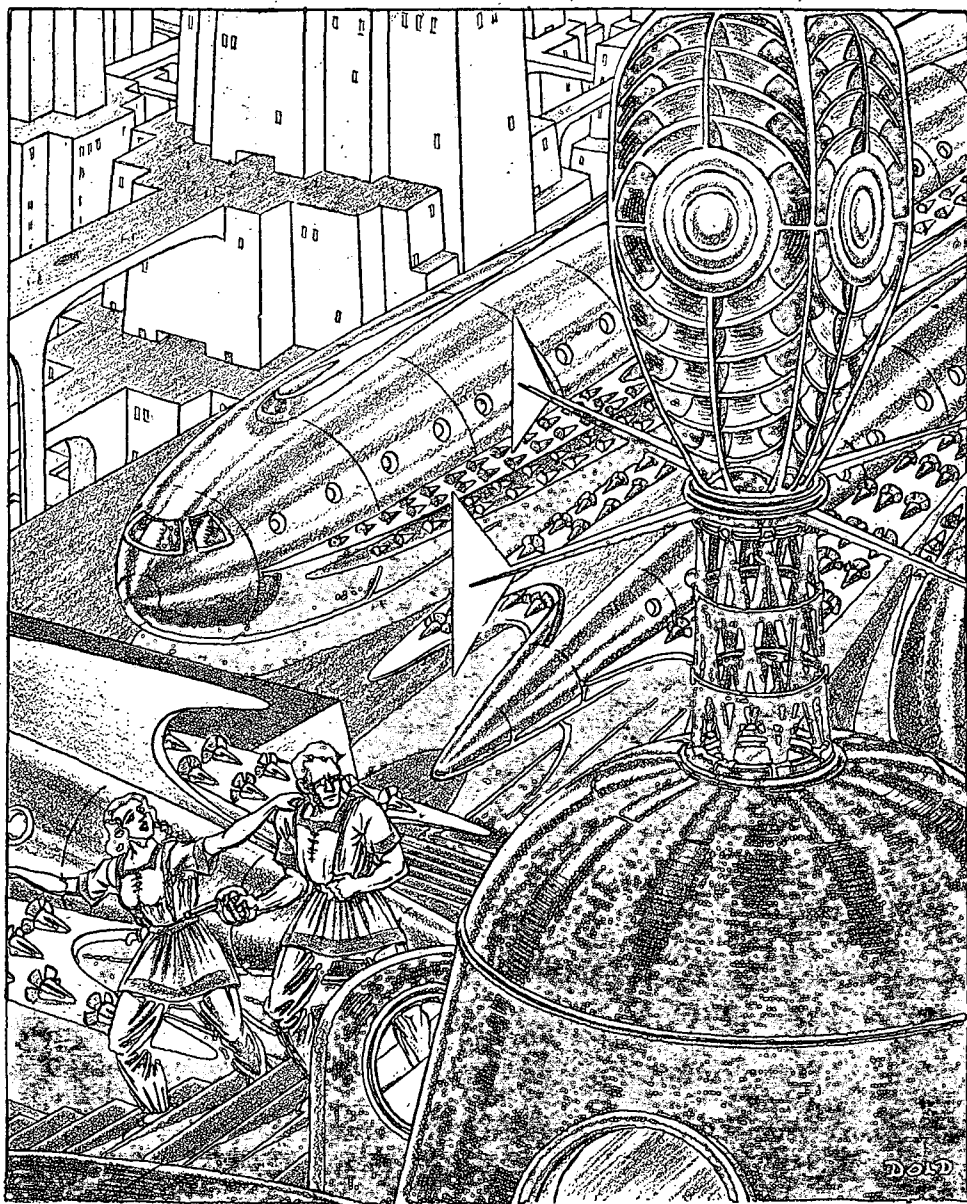


space filled by small rooms. In one of them the girl found a supply of preserved food and they enjoyed another long-delayed meal while the ship was traveling under automatic control.

Martin watched with interest as small rural settlements passed beneath. One fair-sized city was seen in the distance, but they didn't approach. Hours passed

while the ship cut through the air at full speed; the girl took no chances of being overtaken.

In the early afternoon the speed automatically cut down till the ship circled over a large farm. When the girl returned to the controls it settled without sign of forward motion and only a soft whirl of propellers, landing directly be-



A glance about convinced him the science of the blue-men was far ahead of Earth.

hind the huge barn. The runner was only necessary for fast landing or take-off. The barn doors swung open as it touched the ground, and the hull slid into the building.

Before opening the port the girl put

her finger to her lips, warning Martin not to speak. It puzzled him, as he couldn't talk their language, but understood that he was to voice no sound.

As they stepped from the ship, six white men bowed low before the girl

and a moment later they began falling over the shining metal from an upper loft. In five minutes the ship would be completely hidden.

The farm buildings had all slanted walls like the large structures of the city. It appeared to be the standard style of architecture. As men constantly passed in performance of some task, each one bowed slightly before Conway's companion.

A man hurried to meet them as they approached. He didn't seem to notice Martin as the girl ran to his arms. After a moment he turned and placed his hands on Conway's shoulders. The tone of his voice made the stranger feel perfectly welcome.

DURING THE TIME in prison, Martin had learned to pronounce a few words of the new language, and was not surprised to find they had been used by the prisoners to berate the blue-men. With each passing day he mastered a few more words, until he could carry on a simple conversation. Gradually he learned that the girl's name was Ailec, and they were living with her brother Shilg. He took keen interest in this language, determined to learn the background of this strange world. The workmen were told that the stranger suffered a brain-injury, and had lost his memory of speech.

Weeks turned into months, while the farm crops were harvested and stored away. Several times Shilg went to the city of Wemac, where their home was located, and returned with other workmen. The views of the people on this one farm seemed to differ from all others of the white, although Martin didn't know why. He still did not dare talk to the outside men. Until he understood more about their lives, his ignorance might lead to revealing breaks and trouble. He was given the name of Randic Torb of Sandow, to allay suspicion of his origin. When he contacted the white

race in the city, he must be one of their own race.

Conway spent many hours puzzling over his transfer from the former existence. He could not be on the same planet, yet seemed to pass from one world to the other while his plane was under the effect of terrific vibration. The white race, as well as the blue-men, seemed very strange. When he questioned Ailec she seemed disappointed.

"My people came from your world, Randic. I thought you knew. Why did you fly over here?"

Martin was stunned! These people came from the same world as himself—and thought that *he* had come intentionally! Ailec listened in amazement when he described the vibration the plane had passed through, ending with awakening in the hospital in Yrano.

"That is very strange, Randic. My brother and I thought you came here to join us. Perhaps you do not want to join the free-thinkers?"

"The free-thinkers?" Ailec was talking of things which he didn't understand.

"Yes, Randic, free-thinkers! Other members of my race do not realize the lives which they live. When they are young the blue teachers make them believe that all blue people must be worshiped. White children grow up in the thought that some day they can serve their masters.

"Shilg and I went to school, but the eyes of the blue-men did not affect us. Our father came from a mining town, where there is no school. When he went to school in Lemac, after we moved there, their teachings didn't affect him. He pretended they did, in order to avoid the death penalty.

"Every person on this farm would be condemned to death as free-thinkers, because we are not controlled by the minds of the blue-men. When you go to Lemac you must act as if their desires were all that mattered. They

permit no one to live who believes otherwise. Even the white race would want to see you punished if you spoke against the blue people."

IV.

SUDDENLY the truth struck Martin. *Hypnotism!* He had seen demonstrations of its action, but here it was used to control an entire race. People who were not susceptible to the blue-men's control were executed. The conditions under which the white people were forced to live were sickening.

"The blue-men have taught us that we do not belong in their world and must be thankful they allow us to live," Ailec continued. "There were only twenty-one of my race when they arrived in this world, but now they outnumber the blue. Perhaps they did not come from the same place you did, but you look just like us. Shilg and I decided that you must be a descendant of the same people.

"Do you think the white race should be taught to worship the blue-men? No one on this farm does, but we are almost alone in our thoughts."

Martin's answer was almost a shout. "I do *not!* If I can help to change it, I will. Have you and Shilg planned any action?"

"We have done very little, because we cannot make free-thinkers of those now under the blue-men's control. We hoped that you would be able to.

"Without a change in belief, they will do nothing. At present, the white race is satisfied to worship the cruel rulers although they are made beasts of in Yrano, slaving many hours each day. But the mental control of the blue-men makes rebellious thought impossible. Sometimes one of them slips from the mind control of the blue-men, and is sent to the cage prison.

"I was taken to the capitol to dance in one of the theaters, but refused to entertain without clothes. In this way they

discovered that I was a free-thinker, and placed me in one of the cages. They believed that I had changed only recently.

"Several times blue-men came to look into my eyes, but father taught me to avoid their thoughts. When you arrived in prison I had been given up and was to remain there. They intended me to starve to death.

"I learned that you came to the great forest in a strange type of ship. The blue-men took you to the hospital and made you well, hoping that you might serve them as an inventor. They do not understand where you come from, or where your strange ship was built. It has made them uneasy. I learned this from the conversation of people who watched you in your cage.

"The buildings were all designed by the white race, and the cities developed by them. When a great doctor or inventor is discovered among my people, he is taken to Yrano and his work credited to the blue-men. I know these things because I'm a free-thinker.

"It is too bad that you are not a great man. We thought you came to this world intentionally, and Shilg hoped that you could look into my people's eyes and change what they had been taught.

"When the white people are separated from the other race, some of them begin to think for themselves. In all of our cities they are watched constantly, and sight of the purple eyes for only a moment gives back the belief of their childhood.

"If the blue-men discover a free-thinker, they become hysterically angry, and no treatment is too horrible. They believe it is an insult to their intelligence when a white man does not live under their thoughts. You were sent to the cage prison because they could not control you with their eyes.

"My people were ignorant when they were transferred to this world, several hundred generations ago. Since then,

they have developed until their brains are more advanced than those of the blue-men, except in control of other people. We have been slaves from earliest history, and want to change."

Martin's brain whirled in circles. He had learned so much in a short time that it was hard to straighten it out in his mind. The hypnotic control—some strange mental property of those strange, half-insane minds—made it possible for the blue-men to rule, despite inferior numbers and inferior ability. The power of mind was, of course, the one determining factor as to which race should rule a planet. But whereas Martin had always thought of rule based purely on the intelligence factor of mental development, some strange, skew development had developed the hypnotic factor in the blue race. They ruled by the power of superior minds—superior in one, twisted way. In some way, the Earth had created vibration which transferred people to another planet. The same conditions were re-created centuries apart. The first time, a small colony had been moved; when it came again he alone passed across.

The two planets might be light-years apart, or might exist in the same space—it made no difference. There could never be planned travel between. He had been moved to a new world—permanently.

MARTIN was excited when the day came to leave for Lemac. The workmen had been told that his speech-memory had been reeducated, and they pitied him because of his peculiar pronunciation.

He had become Randic Torb of Sandow, a small mining village in a little-known section of the planet, and supposedly related to Shilg and Ailec.

They went to the nearest town to catch a car to the city. When a blue-man walked down the street Randic bent his head beside the other two in a ges-

ture of servitude, while the insane man passed as if they didn't exist.

There was an hour's wait beside the wide-gauge track, before a car appeared. It was traveling at terrific speed, but came to a smooth halt before them.

A toothed rail, halfway between the smooth tracks, puzzled Conway until he saw gears beneath the car. They were used for both power and braking, while the weight of the car slid along the smooth rails. The railroad appeared to be electric, although there was no power-line nearby.

The car was shaped similar to the airship that Ailec had had stolen from Yrano, with twelve seats on each side of a narrow passage. Each seat accommodated three people in ample comfort. Except for the red-leather upholstery, every fitting was of metal. The car hung low over the rails, and high speed did not cause the slightest feeling of unease.

Shilg's clothes fitted so tightly that Martin hardly dared sit down, but they had to do until more could be purchased. As the operator of the car glanced at them, Shilg stiffened. A moment later he was talking to him. The man's eyes were as bright and clear as those of the free-thinkers. All other white people had an uncertain hesitant stare.

Porjor Brolk, Ailec's father, was one of the wealthiest men in Lemac, and because of his prominence it was dangerous for her to enter the city. Everyone knew she had been ordered to dance in Yrano, and her appearance would cause comment. She could stay only long enough to see her parents, then must return to the farm for hiding.

Randic would help Shilg carry on the work of the free-thinkers. There was small chance of his being recognized among the three million white people.

Yrano was the capitol of the largest nation, with six million blue inhabitants. The ten million white population under its rule were distributed in eight cities.

Lemac was the largest, where all heavy manufacturing was done. Other cities were business centers for rural population.

The other nations of the planet were much smaller. The capitol of Borhor housed but two million blue people, ruling a white population of four million. Zerdac was even smaller, with one million blue people ruling three million white.

Each nation drew all labor from its white cities. The blue-men occupied the capitol of each country, where they lived lives of ease, with the white race slaving under their hypnotic control.

As the car drew into the terminal of Lemac, Shilg rejoined Ailec and Martin. While passing through the crowded station, the girl walked between them, where there was little chance of being recognized. A private car waited in the avenue, and they were out of sight within a few minutes.

Even the road cars, which accommodated nine people, were electrically powered, passing through the city noiselessly on streets without pedestrian traffic. The thoroughfares were hard surfaced, as the white race wore loose fitting sandals. Martin found himself in a busy, industrial city.

THE STRANGER was greeted by Porjor Brok as an honored guest. It was custom to supply visitors with funds for travel or entertainment, and Martin found himself equipped to enjoy the city in every way. But each time he mixed with the crowds of people, his heart ached over their strange, uncertain condition.

When Ailec had returned to the farm, Shilg thought about what he had discovered during the trip to the city. The operator of the car was a free-thinker—under the most adverse conditions. Blue-men looked into his eyes daily, yet he avoided their mental control.

There was something very significant

about the origin of every free-thinker. They were *all* employed in work which kept them in contact with *electric power*. With that in mind, he visited the power house in the city. He discovered eighteen men who had been hiding their independent spirit.

Everywhere that power was used extensively he recruited more men, until the organization numbered almost three hundred. Randic, searching for the cause of release from the hypnotic spell, began to experiment with various types of radio waves.

Electric power was broadcast from the central plants. Every type of equipment that required energy picked it up with a small receiving set. This system of distribution gave Randic all the power he required for every experiment, although it eliminated any type of radio communication.

One day when he left the experimental room, where he had been working, to join the Brok family at the evening meal, he found great excitement. *Every person in the house had been released from the blue control.*

Shilg's mother looked at them with clear eyes for the first time in her life. Love for her husband had been her only reason for her faith in his actions. During the time that her children had been growing up, she always believed them wrong in disliking the blue-men. Porjor Brok was completely happy for the first time since they were married.

Randic's discovery of release from the hypnotic control meant that equipment of sufficient power could free every member of the white race. Yet they dared not use it. If the people were freed, they would simply be slaughtered. They had no fighting equipment, but the blue-men were well armed.

Randic learned one very amazing thing about the blue race. During one season of the year, each blue couple went into seclusion for a period of three months. At the end of that time they

either appeared with offspring, or could not become parents before the next season. Even their white servants knew nothing of the means of regeneration.

During the mating season, only a skeleton force of blue-men remained in each city. It meant three months when the activities of the free-thinkers would be fairly safe.

Randic constructed a machine large enough to send forth radio waves to free the entire population of the city. When it was completed, only a month remained until the blue mating season would begin, yet they seemed no further advanced than before. They *must* have weapons!

V.

THERE WAS constant danger that one of the free-thinkers would again fall under the hypnotic spell. Under dominance of the other race, he would tell everything he knew of the activities of the small group. For this reason, Shilg sent many of the new recruits to his farm, where there was less danger of contact with blue-men.

As days passed without solving the problem, Randic and Shilg went sleepless. It seemed that every chance of freedom was slipping away. Two of their group had been discovered by blue-men and sent to the cage prison in Yrano. These two might break down under the inhuman treatment, and tell of the free-thinking group in exchange for release.

The blue-men were cunning, for all their insane minds. They kept heavy armament on all of the freight ships, prepared for any uprising of white slaves. In sparsely settled sections of the planet they occasionally destroyed white towns that grew out of control. Then a new group of laborers would be sent to replace those who had been killed.

White lives were of no importance to them, and killing a few thousand simply caused annoyance. They were afraid of

the white cities, and were always prepared for trouble without realizing that only the settlements without blue-men caused difficulty.

One night Randic had an idea. It was foolhardy, but he was getting desperate. The blue mating season was already well advanced. To his surprise, Shilg readily agreed to the dangerous plan.

Each capitol of the planet kept a fleet of well-armed ships. Their arsenals were filled with guns which could equip the white population. Randic had decided to obtain some, and there was no time to lose.

The number of blue-men in Lemac had been cut from one hundred thousand to less than ten thousand, but each man carried at least one of the peculiar pistols. Even the white police were armed with clubs only, and would be helpless before well-equipped men.

The guns were fired electrically. Each shell contained a chemical which expanded explosively when heat was applied. A small heating unit in each chamber expanded the fluid until the pellet was sent through the barrel at high velocity. When the pressure within was sufficient to force the pellet from the shell, it left the gun with force enough to kill at several hundred feet.

Even the small guns were fired by energy created in the central plant, but they had to be near the source of supply. Randic couldn't understand the system of broadcasting, but was satisfied to know that he could obtain power for the anti-hypnotic machine, while it remained in the basement of the Brolk home. He and Shilg spent a month planning every detail, before they were ready to act.

The day Randic left the city in a fast ship with thirty men packed in the small cabin, Shilg arrived at the farm. An hour later, the ship which had been hidden beneath the hay rose into the air, and followed the same course.

They traveled slowly, and were within

sight of each other before many hours passed. Randic was following a wide route, to reach Borhor without causing suspicion. Every man on board the ships realized they stood slight chance of returning alive, but willingly entered the adventure.

The two ships landed in wild forest country when darkness came. Before daylight, seven more ships had landed nearby. The party now consisted of two hundred and seventy men, each armed with a small sword. Only thirty-three of the men had guns, stolen from blue-men.

On board each ship was a store of small explosive balls, which had been manufactured in the barn on Shilg's farm. They would be deadly when thrown a short distance, but useless at long range. In Randic's plan, they would see only hand-to-hand fighting, where they would have the advantage.

Randic received a shock as the pilot of the ship from the farm, stepped from the port. It was Ailec! She had refused to let anyone stop her from joining the hazardous adventure. Randic was glad, yet fear for her safety kept him worried.

THEY TRAVELED only at night, and a week passed before they crossed the border of the strange country. Every man was nervous and excited. They were going to enter a blue city, and attempt to accomplish the work of several thousand men. On their success or failure depended the future of the white race.

When the lights of Borhor appeared, they were keyed to high pitch. Every member of the party had made up his mind to die in the attempt to win freedom for his people. If these men failed—they would die fighting!

The ships separated before passing over the buildings, and five of them remained out of sight. They hung just beyond the glow of lights, like vultures

waiting to strike. They circled slowly until they saw their destination—the central airport of Borhor!

The four ships under Randic's command flew straight across the center of the city, within plain sight of the people below. When they reached the last of the high buildings, each settled on one of the flat roofs.

Shouts and screams came from the avenue below, as the blue-men saw ships settle to the roof tops. When small explosive balls began to land in the streets, everyone ducked for cover. Armed blue-men appeared in the distance, rushing to fight the invaders. As they came closer, they dodged from door to door, where there was some protection from the rain of missiles.

The natives of Borhor couldn't attack with airships for fear of damaging their own buildings, but slowly worked their way up through each structure. An hour passed before the first blue-men reached the roofs, where hand-to-hand fighting began. The minute it appeared that serious casualties might result, Randic motioned his men back within the ship. The other ships from Lemac soon joined them.

A commotion in the street below told him that it was useless to remain longer. The blue-men had discovered what was happening on the far side of the city, and were heading toward the arsenal.

At the first sound of fighting in the distance, Ailec led her ships to the airport. They no sooner touched the roof than the white men swarmed to the entrance of the structure. Five minutes later they controlled the building, and were pouring into the street. Each man carried a dozen of the explosive balls, and the blue-men ran out of their way with all speed.

The arsenal was only a block away, and they were transporting arms to the airport within fifteen minutes. By the time their actions were known to the blue guards, who had gathered at the

scene of the first attack, the building was almost emptied of fighting equipment. It was slow work to move the guns to the roof in the slanting cars. Holding off the blue fighters with the small explosive balls, the whites worked like demons, and the equipment gradually disappeared from the ground level.

When Randic landed on the roof with his four ships, most of the arms were already there. With the additional help, equipment moved faster, although the fighting at the entrance of the building increased with every passing minute.

As soon as a ship was loaded, a man climbed into the pilot seat, and set the course for Lemac. Each was to reach the white city with all possible speed, not attempting to contact other ships of the stolen fleet.

Ailec was directing the fighting at the street level, but Randic dared not leave the roof to join her. He was busy loading and preparing the cruisers for the long journey. Discovering that they had captured more vessels than there were pilots, automatic controls were set to carry the ships to their destination, in the hope that some of them might reach Lemac without human aid.

WHEN THE LAST of the guns were loaded, the white fighters retreated through the building, allowing the blue-men to enter the lower floors. They destroyed all but two cars, which brought them to the roof, and jammed these when they reached their destination. The blue guards could only reach the roof by climbing thirty-six flights of stairs.

Suddenly flames were creeping through the huge building! The blue-men had lighted inflammable chemicals in each of the air shafts, and fire shot to the roof in a few minutes. They planned to destroy the ships rather than have them fall into the hands of the white attackers.

The metal of the roof was growing

hot as Martin forced Ailec into one of the last ships. Small spots of fire showed in several places. The building would be an inferno within a short time. He didn't approach a ship until every other man had started. The last huge battle cruiser stood before him.

When the port shut he settled into the pilot's seat. As his fingers reached for the control—the huge hull rolled over on its side. The roof beaming had given way! As the craft started to sink lower through the opening, he climbed through the tilted port and raced to a section of roof that was not burning.

A slow smile spread over his face. He was trapped on the burning roof of a building on a strange world! Perhaps his work would mean success for the white race—but he would never see the result. He sat down on a small bench to watch the hull of the huge airship as it sank slowly below the level of the roof, wondering when the arms would start exploding.

Suddenly a dark shape loomed a few feet away, and he raced toward the opening port. Ailec had returned for him! She had waited a few hundred feet away, to make sure that he escaped with the last ship, and had seen it roll over. Although it seemed like hours, only minutes had passed.

They sighted several ships before they had been in the air ten minutes. All were going in the same direction—toward Lemac. It was useless to try and hide their actions now, and they headed toward the white city by the shortest route. Some of the ships might never arrive, but Randic hoped enough would reach the destination to supply the Lemacians with fighting equipment.

On the third day they sighted the white city. As soon as the first ship appeared, Shilg was to send forth the antihypnotic rays and release the white people from their servitude. Then all power in the city must be shut down for a few minutes, to disarm the blue-

men. The small guns could not draw power from a more distant station and would be useless, until the power in Lemac was broadcast again.

Randic and Ailec watched in amazement at sight of the mass of unpiloted ships circling over Lemac. In the hurry of escaping from Borhor, they had not kept track of the number of captured vessels. But the sky was black with slowly circling craft. Their automatic controls kept them from bumping together, but they also avoided contact of ships with which men tried to board them.

A huge game of tag was taking place, with pilots seldom touching their objects. The deserted ships dodged away as if they were living things, playful sky-whales afraid of letting anything get near. Fifty feet seemed the closest that two ships could come before the automatic controls sent the empty craft circling away.

As Randic landed their ship on the roof of the airport, Shilg met him with frantic eyes. He had been trying for almost three hours—and only captured two of the ships!

VI.

AS THE CROWDS suddenly realized their freedom from control of the blue-men, they felt lost. Most of them were wandering around the streets, gazing at the city in awe.

Over half of the blue-men had been destroyed, and the remainder were locked in a building under guard. But the city would be helpless until the population prepared for trouble. They were watching the game of tag in the sky overhead, as if it were done for their entertainment.

Randic and Shilg knew that an attack from the blue-men would come within a matter of hours, and a white army must be prepared to meet them. After all the preparation, it seemed that the white race would let the one chance of

freedom slip away without resisting.

As piloted ships from Borhor landed with the arms and ammunition, people seemed to take more interest. Of the two hundred and seventy men who had started on the trip, only one hundred and eighty returned without injuries. Sixty wounded and thirty dead were carried on the ships. But the one hundred and eighty men began to restore order in the city.

Their relatives and friends listened to frenzied appeals for help, and an army of recruits soon gathered a few blocks from the airport. Officers were appointed from the former police force, and the men obeyed every command. Their willingness made up for a lot of training. Soon, a circle of well-armed men had surrounded the city, to guard it on every quarter.

Randic asked for volunteers to try and capture the drifting ships above. They would be needed to fight the blue fleet when it appeared. The men had captured one hundred and forty-four Borhor ships, and fifty-four of them were sailing around helplessly above the city. There had been only ninety pilots among the uninjured men.

Shilg explained the action of the automatic controls that caused the ships to dodge away from other craft, and Randic had formed a plan.

When his ship came within a hundred feet of the first derelict, he lifted a gun to his shoulder. At the third shot, a hole appeared in a round disk on the side of the floating craft. He had destroyed the sensitive apparatus which warned of another ship's approach. They were able to draw up to the vagrant hull.

Three ships were captured in this way, and the men distributed. One of them returned to the port for extra pilots, while the other three carried on the work of capturing the armed cruisers. In two hours every ship rested

in port, and the men breathed a sigh of relief.

As the ships were prepared for battle, and the crews instructed in their duties, eyes turned anxiously toward the sky. The blue-men might appear at any time, and when they came there would be many. An army would attack on the ground as well.

When several hours passed Randic felt more hopeful. The city had quieted down, and the people were doing everything possible to aid in the preparations for defense. The activities of the metropolis had settled down to routine, and defense works were being built at the outskirts of the buildings.

The blue mating season had ended. Yrano would send a strong army to put down the revolt, and the white city could expect overwhelming odds on every side.

DARKNESS came without sign of attack, but every inhabitant realized that it would come before many hours. Three ships were cruising in the direction of Yrano, to give warning of the enemy's approach. The men rested while they waited for action.

The sky was lighting with the first break of dawn when one of the ships came racing toward the city. Under cover of darkness, the blue army had come within a few miles of Lemac, and the fleet was seen leaving Yrano. Within an hour the fighting would start, and the white people anxiously waited—to wipe out the stigma of generations.

The fleet of one hundred and forty ships looked very inadequate when the ships from Yrano appeared. Fighting had already begun on the outskirts of the city, with Shilg in command. Randic led the white fleet toward the approaching ships.

His heart sank. They would be outnumbered five to one! But they would make a showing that the blue-men would long remember. Each of the ships from

Lemac carried a supply of the explosive balls, as well as their heavy armament. The guns on the battle cruisers fired shells of one-inch diameter, but the range was very short. They were fired by the same expansive chemical used in the small arms, but with heavier missiles their accuracy was lost.

The white fleet had been ordered to keep above the other ships, if possible. They were not armored, but the heavy metal runner would withstand shells from the guns. If the blue-men didn't discover the strategy, it would be quite an advantage.

As the fleets drew together, the blue-men allowed the white to pass above them. It allowed better aim with their guns, since shooting from above was much more difficult. For several minutes their positions didn't change, then the blue fleet began to have casualties.

Seven of the giant ships dropped toward the ground, while only one craft under Martin was disabled. After this exchange of hostilities, the blue-men realized their mistake and began to jockey for position.

As the Yrano ships tried to reach the level of the white fleet, Martin realized he had an unexpected advantage. The nearest enemy ship was only three hundred feet below his flagship. He let the huge craft drift as he jerked open the port and threw one of the explosive balls, then two more followed. One of the small missiles struck the blue cruiser near the forward end, and jerked it from its course. As the second one hit, it seemed to crumple. One of the side fins had been injured beyond repair. Suddenly it turned in a wavering circle and dove headfirst into a companion ship.

The sound of explosions, echoing above the clash of battle, caused action to cease for a moment. Every eye watched the result of the new attack. Then hand-thrown weapons began to drop from every white vessel.

The blue ships were at a disadvantage as they tried to dodge the containers of death from above, and casualties mounted at an alarming rate. When they avoided the missiles from one Lemacian ship, they came within range of another. Before the insane commanders realized the new danger, their crews were completely demoralized.

Suddenly a blue ship streaked away, followed by another and another. In fifteen minutes the fleet from Yrano was in complete rout, trying to escape the wrath of the white men. The unstable minds of the blues could not long endure severe losses. The Lemacian fleet followed, dropping messages of death from above.

When the defeated ships reached Yrano, the white fleet circled grimly over the city. Explosive balls drove every citizen within the protection of their largest buildings, and an hour later the city surrendered to avoid greater damage. The blue-men utterly lacked morale to resist punishment.

ALTHOUGH RANDIC was short handed and couldn't occupy the blue capitol, he captured every ship in the city. Two hundred and seven cruisers headed for Lemac under pilots, while three hundred deserted hulls started for the white city under automatic control.

Every eye strained ahead as the ships tore across country at terrific speed. At first sight of Lemac their hearts sank. The white army had been driven within the outlying buildings—while the blue army slowly advanced!

Half-hearted cheers greeted the return of the victorious fleet, although the army was fighting desperately to keep the blue-men out of the city. Shilg was almost hopelessly, as he rushed to the airport to meet Randic. The blue-men were using cannon which far outranged the small guns captured in Borhor, as they had been unable to carry off the heavier weapons.

Randic issued orders, and within a few minutes the ships were being loaded with the explosive balls which had been useless to the army.

As the cruisers circled over the line of battle, the blue-men looked up anxiously. The heavy metal runners were protection against the light weapons, while the heavy guns could not be elevated to bear on the ships. The light explosives from above on the other hand, caused terrible havoc amongst the blue forces.

In thirty minutes the army had suffered terrific casualties. Immediately, retreat turned to rout, as the men dashed across the open country to escape the dropping explosives. When a group of men threw away their guns, they were allowed to escape uninjured.

Lemac was a free city!

FOR DAYS the people celebrated their victory, while Randic walked the streets with a worried frown. The work of freeing the white race had only begun—and they were allowing the blue-men time to prepare for future conflict. A week passed before the Lemacians settled down to routine again.

As soon as an anti-hypnotic machine was built and installed on one of the big ships, Randic was ready to visit other cities. Every ship of the captured fleet was manned, and four hundred and fifty of them took to the air. Fifty-seven remained at Lemac ready for instant use in emergency.

As the anti-hypnotic waves were sent forth above each white city, fighting broke out with the blue guards. But it was always of short duration. They seemed almost glad to surrender to the revolting white men.

Borhor fell, followed by Zerdac. One city after another surrendered, until every white man on the planet was freed from slavery. One battle cruiser remained in each of the cities, to tell of the happenings on the planet, while the

inhabitants went wild with rejoicing.

At the end of the long trip, Randic received a mighty welcome from the people of Lemac. When Shilg led the way to a car with strange emblems on each side, Randic began to wonder. As his friend climbed in beside him and they led a gigantic parade through the streets, he was more amazed. He was dirty and tired from weeks of travel, but Shilg insisted that he attend a meeting of the councilors before going to his apartment.

As they marched into the largest hall in the city, several hundred men rose to their feet. They had been waiting Randic's arrival from the airport. Every white city on the planet had representatives in the gathering, and Randic turned to his friend questioningly.

Shilg didn't stop to explain, but led the way to a dressing room behind the raised platform and handed him a fresh blouse. A design on the front resembled the insignia on the car, and Randic's forehead wrinkled in a deeper frown.

When he appeared on the platform, the room echoed with cheers from the crowd. Randic stood in the center of the raised section, trying to discover the reason for their animation—then their words seemed to burn into his brain!

"RANDIC TORB—RULER OF THE PLANET!"

He shut his eyes, trying to grasp the significance. Delegates from every city

had gathered to pay him the highest honor they could bestow. He felt a catch in his throat. As he saw Ailec in the first row of people, his weak smile drew the attention of the crowd.

For an hour Randic was happy. He had been given the highest possible honor and position. These people had taken him to their hearts. Then he heard bits of news that were disturbing. Every white slave had been freed. There was not a single white man within the walls of any blue city on the planet! The insane race had seemed anxious that their former servants leave as quickly as possible. On the surface they had accepted the change in conditions without a murmur, as if they almost enjoyed it.

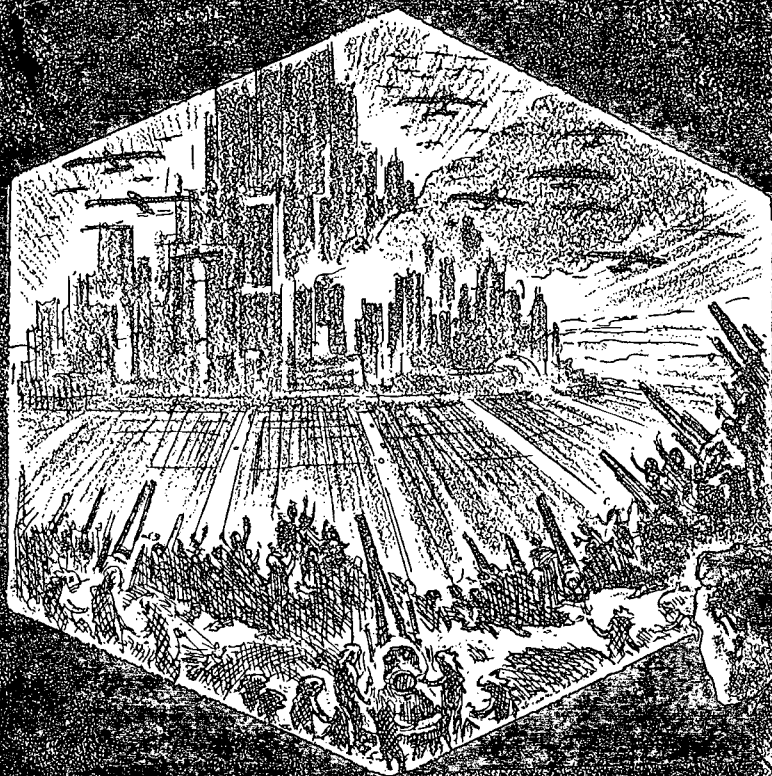
Suddenly Randic felt sick. These people had given him a terrible task. The blue-men were too quiet. Trouble was brewing, and he had no means of knowing what it would be. Cowards the blue-men might be, but they were far from stupid. Randic realized that he must act fast. He must have an army and air force that would be invincible. But that would be little satisfaction until he knew how the trouble would come.

The palace, which was formerly occupied by high-ranking blue-men, almost mocked him with its magnificence. For a moment he had thought he had been paid a great honor. He knew now he had actually been handed the responsibility of the entire white race.

WATCH

The February **ASTOUNDING** will make one of the most important announcements in the History of Science-Fiction!

SAURIAN VALEDICTORY



BY NORMAN L. KNIGHT

SAURIAN VALEDICTORY

Man's brief history of ten thousand years is all he knows. And Earth has had two billion years!

*In all that vast time, has no other people
risen, fallen, and been forgotten?*

THREE men and a woman stood on a ledge before the mouth of a cave, high on a mountainside in the Ozarks. The night air vibrated with the trilling of myriads of crickets and tree-frogs. Heat-lightning quivered along the black rim of the horizon, and the ragged banner of the Milky Way spanned a sky of lucid clarity studded with a watchful host of stars. The ledge had been carefully ground down to uniform smoothness and was rimmed by a parapet of natural boulders set in concrete. The mouth of the cave was closed by French windows through which could be seen a portion of the spacious cavern, transformed into a living room and suffused with the cheerful glow of electric light.

The four who stood upon the ledge were Penstone, the owner of the cave and the mountain; Mosgrove, the architect, who had translated Penstone's nebulous ideas into blueprints; Elza, Mosgrove's wife; and Ormrod the neuro-physicist, another of Penstone's friends. Penstone would have taken possession of his cave with no ceremony whatever, but he had been prevailed upon by Mosgrove to celebrate the housewarming—or rather, cawwarming—by inviting this small, select group. An observer from the early twentieth century might have deduced from the raiment of the four that they had recently participated in a tennis match, although he might have been puzzled by a certain metallic shimmer and sparkle which enlivened their costumes. It was the type of clothing then generally con-

sidered appropriate to such occasions.

"It really grows cold in these hills, after dark," shivered Elza. "Let's go in."

"Who closed the windows?" inquired Ormrod.

"They closed themselves," Penstone informed him, and advanced toward the French windows. Standing before them, he commanded in a resonant voice: "Open, Slave of the Windows!"

And forthwith the windows parted and folded back, accordion fashion, on either side.

"Why, how clever!" cried Elza.

"It's a sound-lock with a selective resonator," Mosgrove announced with a touch of pride.

"Same old Mosgrove—the builder of dramatic houses," remarked Ormrod.

Within, the cavern was a curious blending of primitive nature and modern ingenuity. A strangely fluted stalactite had been transformed into a chandelier. The furniture was wrought of a light, tough substance known as vitrolith, stony to the eye and sense of touch. The radio cabinet, coated with vitrolith, was built into a natural grotto. A huge, cobblestone fireplace dominated the room, and an hexagonal black mirror, five-feet across, was set into the flue above the mantel.

"Come on, Penstone, pour us some drinks and light the fire," urged Ormrod. "We'll drink a toast to your new home."

When Penstone had poured the drinks he knelt before the fireplace and made mystic passes over the logs and kindling which lay therein, muttering unintelligi-

ble words. And obediently the kindling burst into flame.

"Well, I have never seen *that* done before," declared Elza. "How did he do it?" she demanded, turning to her husband.

"It was done with a photo-cell," replied the architect. "Penstone's hands intercepted a beam of light, and that lit some little gas-jets, which ignited the kindling."

"All the comforts of home," remarked Ormrod. "Your own artesian well, hot and cold water, telephone, radio, and natural air-conditioning the year round."

"And don't forget the elevator to the hangar on top of the mountain," added Mosgrove.

"But, what really takes my fancy is that black mirror over the mantel," Elza observed. "It has a kind of velvety appearance. Is it glass, or something else?"

"I was waiting for you to ask about that," replied Penstone. "No, it isn't glass. It's a slab of tourmaline, just as we found it, except for some polishing. It was incased in a thin shell of silica. That is, it has the composition of tourmaline, but its size and hardness are abnormal. It came to light when we were enlarging one of the other chambers. Its age is at least fifty million years—judging by the estimated age of the formation in which it lay—but it couldn't have been formed in the sedimentary rocks which inclosed it. It must have been transported by floodwaters from another formation. Mineralogically speaking, it's a freak."

"A mirror fifty million years old! What a treasure!" sighed Elza.

THE FLAMES in the fireplace mounted higher and laid hold of the larger logs; whereupon Penstone switched off the lights. Only the leaping, ruddy glare of the fire illumined the cave as the four sipped Penstone's kaffina and leisurely discussed possible

means of entertainment during the remainder of the evening. This peaceful interlude was brought to an abrupt close by an exclamation from Elza.

"Look! The mirror! It's shining!" she ejaculated.

"So it is," agreed Ormrod. "Is this another of your surprises, Penstone?"

"If it is, he didn't tell me about it," said Mosgrove.

The lower third of the mirror was glowing with a greenish phosphorescence which spread and invaded the remaining dark surface until the entire mirror was a luminous apple-green hexagon. A wavering, upright, dark shape appeared in the center of the mirror, suggestive of an unusually slender, light-boned human form.

"What did you do, Penstone? Hide a projector in here somewhere?" inquired Mosgrove.

"Tourmaline slab, indeed!" jeered Ormrod. "It's a telescreen."

"This is nothing of my doing," disclaimed Penstone. "It may be that the stuff is thermo-luminescent and is responding to the warmth of the flue."

The four people set down their glasses and watched the mirror intently. The wavering, upright dark shape seemed to condense and solidify, and Elza uttered a stifled sob—half horror, half amazement. The image in the tourmaline slab was not the image of a human being but of an erect, anthropoid creature covered with iridescent, exquisitely small, green scales which gave it the appearance of being clad in very fine-meshed chain-mail. It was shod with scarlet buskins, and a belt of metallic blue mesh encircled its waist. Two objects resembling pistol holsters depended from the belt. Its fingers were excessively long and slender, like the legs of a giant green spider, and a frill of skin encircled each narrow wrist. Its features were unmistakably reptilian—mouth wide and lipless, small nostrils ringed with fleshy rosettes, round eyes of vitreous black

with golden yellow irises. But there was nothing of the usual reptilian flatness in the hemispherical cranium, and from the median line of that cranium sprouted a serrated, fleshy crest like a cock's comb. This crest swelled and contracted, rose and fell, and varied in hue through a gamut of crimson, purple, and mauve. A ripple passed over the pendulous folds of the creature's throat, it opened a salmon-pink slit of a mouth, and there issued therefrom what can be described only as an articulate hiss. The four watchers felt that their minds were suddenly gripped and held by an imperious power.

"Penstone, you've been dabbling in cerebral electronics!" accused Ormrod thickly. "You're playing on our emotions and thoughts with a Mejinsky neurotrode, planted somewhere in the cave! You're giving us a synthetic opium dream!"

"I don't know . . . what's doing it . . . I swear," insisted Penstone jerkily. "The heat, perhaps—"

His voice trailed off into silence.

The theories of Penstone and Ormrod regarding the apparition were not totally wrong but they were far from the real truth. The slab was in fact a mechanism—not a mechanism of gears and electric circuits—but a molecular mechanism, devised by an artificer of incredible antiquity. This artificer had intended that the slab should be activated by gentle electric heat, uniformly applied around its perimeter, which would thereby evoke the latent images and sounds impressed upon the successive layers of its molecules and their force-fields. The warmth of the flue in which the slab was embedded had been equally effective as a stimulus. But the slab also radiated other, more subtle, forms of energy which the science of the twenty-first century was just beginning to discover and to interpret into workable theories.

The being who had recorded his image

and thoughts upon this device had not been content to rely merely upon visual images and sounds to convey those thoughts to the minds of the ancient recipients for whom the message had been intended. In addition, he struck at the very emotional cores of those recipients with subtle neural radiations. Wherefore it came to pass that the articulate hiss which issued from the tourmaline slab was heard as such by Penstone and the others, but its significance penetrated to their not-too-different neural networks as comprehensible speech.

"BEFORE YOU is the likeness of one Thisk-Essif, whom you cast out," hissed the image. "Harken well to my words, since they concern impending perils which threaten all the waning remnant of the race of the Hathestsi. I would speak not only to the Ten Wise Ones who hold the fate of our race in their hands; but to all dwellers in the city of Ishfenferath. I choose this form of communication because I know that the city contains activating apparatus in operating condition.

"Let me refresh and extend your knowledge of some of the facts regarding Thisk-Essif, the exile, by means of reconstructed images from my own memory."

It was somehow conveyed to the four spellbound watchers that Thisk-Essif was not a true name but an impersonal designation—a sort of genealogical index-number in a vast catalog of individuals. Thisk-Essif faded from view and in his place appeared a scene of strange magnificence.

Such was the potency of the force which riveted the attention of the four onlookers that it seemed that they were no longer mere onlookers, but that they had been projected into the midst of the scene portrayed on the tourmaline slab and were present as disembodied spectators. They seemed to be suspended in

air at a moderate height above a pavement of ivory, facing a wall which was one vast translucent mosaic of multi-colored platelets, like a cathedral window immensely enlarged. At equal intervals in this wall were circular flowerlike patterns which seemed to be ventilating fans, but they did not revolve. Instead, they oscillated idly in vagrant drafts of air. A sky of burning blue shone through fissures in the mosaic. At the base of the wall was a dais of peacock green, and on it squatted ten obese reptilian creatures—elephantine caricatures of Thisk-Essif. They were green-scaled and aglitter with jewels and metal ornaments, their cranial crests were mere warty ridges, and they sat cross-legged like ten fantastic, blinking Buddhas.

Before the Ten, at a respectful distance, stood a crimson-crested individual resplendent in azure sandals, golden arm-bands, and a jeweled collar. He was escorted by two companions with crests of black spines. Beyond either end of the dais a restless throng of saurian people hissed and rustled.

"Who is this miscreant? What is his offense?" hissed one of the Ten, while its blue-green dewlaps pulsed rapidly.

"He is Thisk-Essif, O Wise Ones," responded one of the escorts. "He has been reared to become a consort of the Theshts, the Mothers of Ishfenferath, but he has uttered blasphemy. Also, he was discovered examining the pictured records in the forbidden Hall of the Archives."

The Ten Wise Ones leaned forward, inflating and deflating their throats like agitated toads. Thisk-Essif's crest flamed even more vividly crimson. The glowing colors of the translucent wall of mosaic abruptly turned opaque and lifeless, and the blue which shone through the rifts in the wall took on a leaden hue as a swift thundercloud overspread the sky. A furious blast of wind and rain pelted against the wall and

drove in through the rifts in clouds of spray.

"And what was the blasphemy uttered by Thisk-Essif?" demanded the spokesman of the Ten, and its words were as the sound of red-hot iron plunged in water.

"I tremble to repeat it, O Repository of Wisdom," replied the escort. "He has seen the Mothers of Ishfenferath and looks upon them with disfavor. He says—"

"I say that they are but witless slugs, vegetating in their sun-baths among their slaves," interrupted Thisk-Essif. "They are mere brainless egg-makers. I say that we are a decadent race. There was once a time when all the Hathests were natural beings such as I, and they rose steadily to greater and greater achievements. There was a time when nine out of ten were not doomed, before they broke the shell, to the lives of sterile neuters. What new thing have we accomplished in a hundred generations? Of what use are a hundred lifetimes spent in empty admiration of bygone triumphs? Our forbears who built this city had in mind for us no such destiny as this; they did not conceive that their science would frustrate the lives of countless millions. Now the city crumbles about us and we do not rebuild it. We do not know how to rebuild it. Year by year our machines fall dead and silent, one by one—the machines which legend said would run forever—and we have not the wit to restore their power. Unless, of course, the Wise Ones possess that wisdom and are withholding it. If that is the case, O Wise Ones, then reveal your secret store of wisdom and justify your title."

AS THISK-ESSIF spoke, the mosaic wall began to glimmer with the flashes of a flickering play of lightning accompanied by a continuous, rolling bombardment of thunder—not loud, but insistent and oppressive, like the grind-

ing of titanic machinery in the heavens. And the scaly bodies of the Ten expanded visibly with wrath, while their distensible throats swelled prodigiously, until finally the accumulated pressure was vented in one mighty, simultaneous hiss.

"Thisk-Essif, by your own words you brand yourself an impious materialist, and betray an utter failure to comprehend the noble principles of our social order," sibilated the spokesman of the Ten. "There seems to be an evil vitality in your type which generations of selection have not eliminated. You see only a crumbling city; we see a sublime monument to the subjugation of the individual to the racial welfare. You see only a gradual decline in our mechanical resources; we see a race which has achieved a perfect society by means of these artificial devices, and having achieved it has no further need of them. You would shatter that perfection and cast us again into a feverish existence of stress and change. You would not understand the beauty of a life of contemplation, of intellectual and emotional adventure. As to your attitude toward the mothers of our race, we have no words to express our horror and revulsion. You are an atavism, a dangerous and destructive mentality, and we hereby decree that you shall be publicly dishonored and banished from Ishferath forever. We deliver you to whatever fate may await you in the outer world, beyond the protection of this city which you have dared to despise."

The listening throng hissed softly among themselves, with a sound as of a light wind among dry leaves, saying, "The Ten speak truly. What madness has stricken this hapless one, Thisk-Essif?"

The outer storm passed as quickly as it had descended, the mosaic wall bloomed again with color, and the audience chamber of the Ten vanished. In its place appeared a spacious cor-

ridor, the ceiling whereof was supported on the shoulders of a double row of tyrannosauri molded in lustrous black material. The granite floor was channeled by the feet of generations. Along this corridor marched Thisk-Essif, stripped of his sandals and ornaments and coated from crest to toe with white pigment—which by saurian standards was the color of dishonor. A long white tail of vegetable fiber dragged behind him as the symbol of his abysmal degradation. (The original appendage provided by nature had been ritually amputated, for esthetic reasons, on Thisk-Essif's emergence from the egg in the communal incubation chambers.) Following the outcast came a troop of the spiny-crested ones, heralding his infamy with a discordant honking and croaking of trumpets, and the clash of brazen rattles.

Flanking the corridor were grilles of silvery metal between the caryatid images, and beyond them were walled gardens open to the sky. Within the gardens were the Mothers of Ishferath—great silvery-green creatures who lay basking on slabs of onyx, or reclined under the cycads and permitted themselves to be fed by attendants. At the sound of the trumpeting and clatter which marked the passage of Thisk-Essif a few of them opened languid eyes or distended their membranous ruffs of translucent green in token of their transient interest, then relapsed into their customary somnolence.

But the flame-crested consorts of these mothers of the saurian swarm clustered near the grille-work barrier and taunted Thisk-Essif, and showered him with the rinds and husks of fruit.

The corridor of the tyrannosauri opened upon a platform where a saffron-yellow airplane rested in its catapult. The wings of the plane were curved and pointed like the wings of a pterodactyl. Thisk-Essif was hustled into the cabin of the plane and, at a signal from the

pilot, the machine was hurled into the air. It sped away from Ishfenferath with no sound save the vibrant purr of its electric drive.

Against a background of receding thunderclouds the city loomed above the plane like a mountain—a vast, roughly pyramidal structure, six thousand feet from base to summit, rising from a boundless expanse of fertile, cultivated flatland. The last trailing cloud-tatters of the departing storm still swirled about it. It was terraced and sculptured and pinnacled, verdant with greenery, and adorned with bas-reliefs and images executed on an incredible scale. A rank of saurian figures with hanging gardens in the palms of their extended hands was among the least of these adornments. It was Ishfenferath, the last magnificent achievement of the vaulting saurian imagination on the eve of its stagnation and decline.

THE AIRPLANE sped across the great circular agricultural area which surrounded Ishfenferath, and soared above the massive defending wall with its sentry-towers and projector-emplacements. Beyond the wall lay a wilderness of steaming vegetation. Beyond this in turn, after many miles of flight, the plane came to earth in a relatively arid region. A sun of unearthly size and brilliance hung in a sky of blinding blue. It drenched the sandy soil, the tumbled rocks, the sprawling desert plants, with a relentless flood of light and heat. On the farthest rim of the horizon Ishfenferath was merely a little mound, purple with distance, flickering in the superheated air. A bank of snowy cumulus clouds floated beyond it.

In the cabin of the plane the pilot turned its spine-crested head and spoke sibilantly to Thisk-Essif.

"That which I am about to do is high treason," announced the pilot, "but you are not the only one in Ishfenferath who doubts the all-encompassing wisdom of

the Ten. In the chest at your feet you will find sandals, a gun-belt, two blast-guns, one hundred rounds of ammunition, and a small knapsack of concentrated provisions. I shall point out to you certain edible fruits of the desert. I shall also assist in removing the dishonorable appendage which is attached to you. Beyond that ridge is a waterhole where you may dissolve your coating of white pigment. It will be wise not to stray far from the waterhole. You may wait only a few hours, or you may have to wait until tomorrow. In any event, wait here."

Shod, and equipped with gun-belt and knapsack, Thisk-Essif watched the airplane dwindling in the sky toward Ishfenferath and puzzled over the pilot's parting words. He stood alone in a blasting heat that quickly would have prostrated a human being. The response of his reptilian organism to the solar bombardment was a stirring and quickening of all his faculties, a mounting elation, rising optimism, a feeling of imminent adventure. Somewhere a herd of grunting reptiles browsed and munched noisily among the desert growths. He turned and scuttled over the ridge.

After he had bathed and removed the last vestiges of his ignominy, Thisk-Essif lingered by the waterhole—it was really an ancient well—and pondered his next move. A stir among the fronds on the opposite bank of the pool caused him to look up quickly. He beheld an ugly black head like the head of a short-snouted crocodile set on massive shoulders. A pair of fierce yellow eyes glared into his and an enormously muscled arm projected from the foliage. The arm was sheathed in an integument of small jet-black scales and ended in a huge fist which grasped an iron-bound club fashioned from the shin-bone of some great reptile. With a thrill of loathing Thisk-Essif recognized the immemorial foes of his kind—the barbarian, carnivorous

Ispznossi, who were everything which the cultured, vegetarian Hathetsi were not.

Two more heads appeared alongside the first. Thisk-Essif leveled his guns at two of the heads, transfixing each one with a whistling beam. They vanished with a thud, in clouds of oily brown smoke. But still more heads appeared. There were five—ten—a dozen—a score—a swarm of them! Of what use were his weapons against such odds? He dared not waste his precious ammunition. He backed away from the pool, then turned and broke into a run. The Ispznossi came splashing through the water after him.

They drove Thisk-Essif like a rabbit. They ran with great leaping strides, leaning forward and balancing themselves with long tapered tails. He crashed through a thicket—and was horrified to find himself in an encampment of the Ispznossi. Near him was a rude platform of matting raised on poles about ten feet in height, and before the barbarians about him had recovered from their amazement at his sudden irruption from the thicket, he had scaled one of these poles with the agility of despair. He found the platform of matting covered with small pottery bowls filled with sand, in each one of which reposed an elongated greenish-white egg. It was evident that the nomadic Ispznossi had here established one of their periodic camps for the purpose of hatching their young.

Possibly Thisk-Essif's wits were sharpened by the rise in his body-temperature, or by the extremity of his peril, or both. Be that as it may, when his pursuers came bursting through the thicket and the entire populace of the camp surged around the platform with menacing croaks and hisses, he was suddenly inspired. He stooped, grasped a coup of eggs, and made a gesture as of dashing them to the ground. For a moment there was complete silence;

then utter confusion. But none of the Ispznossi attempted to scale the platform; and Thisk-Essif stood waiting, feet wide apart, holding the two eggs aloft.

It is difficult to say by what means the Ispznossi would have broken this fantastic deadlock had it not been broken for them by the drone of an airplane in the sky. Thisk-Essif quite naturally supposed that it was his friend the air-pilot from Ishfenferath who was returning with some additional equipment which he had overlooked. At first he saw only a blinding flash as the plane wheeled near the sun, and could not discern its color. The Ispznossi suddenly lost interest in Thisk-Essif. Then the plane drew away from the sun and dropped lower, and behold! it was not yellow, but gray, with straight angular wings. And it flew noisily, with a roaring and spluttering; and a trail of bluish vapor in its wake.

THISK-ESSIF had been taught that in all the world there was no inhabited city of the Hathetsi save Ishfenferath, and that it had but one foe—the Ispznossi. So whence came this alien plane?

The Ispznossi scattered in panic as the gray airplane swooped down above them and gave vent to a staccato hammering noise, clearly audible above the din of its motors. When Thisk-Essif saw the fleeing barbarians falling by the dozen, stricken down by some mysterious lethal force, it occurred to him that his own position was much too exposed. He tossed aside the eggs, slid down the pole, and scurried into the shelter of an overhanging rock. Peering cautiously from this retreat, he saw and heard part of the methodical slaughter wreaked by the circling airplane. Then the craft soared to a greater altitude, and when it was almost above the incubating platform it released a small dark object which whistled downward and struck the ground.

The detonation which followed hurled Thisk-Essif against the wall of his rocky retreat, showered him with gravel, and threw a great fountain of dust and rock splinters heavenward. Only a smoking crater marked the site of the platform when the cloud settled.

A human being would have been stunned. Thisk-Essif was merely astonished and annoyed. He arose, shook himself, and looked forth in time to see the airplane coming to earth a short distance away. It rolled to a stop, its motors banging noisily and ejecting a great deal of blue vapor. The cabin door opened and the pilot climbed out.

"A Thesht!" ejaculated Thisk-Essif, and his crest became perpendicular with surprise.

The pilot was in truth of Thisk-Essif's species, and her translucent ruff was outspread at an angle indicative, to saurian eyes, of intense curiosity. A long-barreled gun hung in the crook of one arm. She uttered a whistling cry in the language of the Hathests!

"Come forth, O crested one!" she called.

"Before I do so, I warn you that I also am armed!" whistled Thisk-Essif.

"Have no fear," responded the pilot. "I carry this weapon merely as a precaution against luring Ispznossi."

And so Thisk-Essif came forth.

"I am Visth, reared in exile," said the pilot as Thisk-Essif drew near. "You also are an outcast, newly banished from Ishfenferath. It is easily seen that you were befriended by the one who brought you, even as other outcasts have been befriended."

"Do I understand you to mean that others have been banished from Ishfenferath, and that they have survived and somewhere banded together?"

"There have been many others, but not all have survived. Sometimes they were slain by the Ispznossi before we could come to them. The Ten are constantly plagued by rebels such as you.

There is a conspiracy between us and the pilots of Ishfenferath, and when an outcast is brought forth into the desert the pilot speaks to us through the air, and we fly to that place."

"Speaks through the air?" repeated Thisk-Essif blankly. Then, "Where are these others?"

"Far to the north is a city in a mountain," replied Visth, "where the Hathests once dug metals out of the earth and drew power from the wind, and sunlight, and steam, and falling water. It was long dead and abandoned. But now we are slowly restoring that city and rediscovering the science of our forefathers, bit by bit. Sssst!"

Visth quickly raised her gun and fired from the hip at a skulking black figure among the rocks. It collapsed and rolled down an incline in a cloud of dust.

"A crude weapon," apologized Visth. "It uses explosive cartridges and soft-nosed slugs—not at all like your weapons, but it is the best that we can make as yet. This air-machine—it also is a crude affair. It burns a distillate from fermented vegetable waste. Now, if you will trust my abilities as a flier—"

A few moments later they were soaring above the still-smoking ruins of the Ispznossi encampment.

"The Ten are living in a dream-world!" Visth shrilled piercingly above the roar of the motors. "The power-supply of Ishfenferath falls lower and lower, and here I find the Ispznossi squatting within actual sight of the city, although distantly. They grow bolder always."

"Disgusting savages! Imagine hatching eggs in the sun, in bowls of sand!" exclaimed Thisk-Essif contemptuously, thinking of the air-conditioned, electrically heated, glass walled, surgically clean incubation chambers of Ishfenferath.

"It is not such a bad method. I was sun-hatched, under glass," observed

Visth. "Ishfenferath will do likewise when the last power-machine fails."

A RANGE of mountains thrust its peaks above the northern horizon and reared into the sky as the airplane drew nearer. Storm-clouds, filled with ceaseless glimmerings of lightning, crawled and flowed among the peaks. Then little blue-and-gold structures became visible among the wooded foothills, clinging to the sheer sides of a valley which inclosed a long, irregular lake retained by a dam. A row of wind-turbines whirled against the sky on a ridge above the valley. The more distant mountain slopes were scarred with excavations and slag-heaps, and were feathered with plumes of smoke from active furnaces.

The plane swooped down to a landing field on a flat-topped mountain spur. Hangar caverns opened upon the field at the base of a low bluff, and from them a throng of the saurian people swarmed forth. A continual mutter and growl of remote thunder rolled down from the high mountain valleys to northward. As Thisk-Essif followed Visth from the plane, a distant volley of sharp reports set the echoes to clamoring among the crags.

"What was that?" demanded Thisk-Essif.

"It is nothing," replied Visth, then added. "A band of hunters is shooting somewhere among the mountains."

From the air field Thisk-Essif was taken by a subterranean way to a curious chamber set in the face of a precipice. The rear of the chamber was hewn out of the rock and was encumbered with great files of records and chronicles—pictorial, phonographic, photoscript, and other kinds—together with their recording and reproducing devices. The forward part of the chamber was a solarium which jutted out from the precipice and commanded a spacious panorama of the

southward forest and desert. Movable sections of the glassy walls and ceiling were thrown open, admitting the eternal rumblings of mountain thunder and a furnace-blast of wind.

In the center of the sunroom a gaunt saurian reposed on a basking-slab of limestone, in an attitude suggestive of a crouching, dragon-headed sphinx. His scales were the grayish-green of lichen-covered rock and his crest was dark red, like old wine. He seemed no less immobile than his basking-slab, but this immobility did not signify lethargy. As a matter of fact, he was visualizing the reconstruction of a hydro-electric turbine. It had been a commonplace of saurian experience, long before the physiological reasons thereof were known, that intellectual effort was most fruitful when the thinker was exposed to the heat of the sun.

"Arise, Thefshath," said Visth, who was among those who had accompanied Thisk-Essif from the air field. "Another outcast has come to our City of Exiles."

The gaunt saurian stirred, rearranged his long limbs, and rose to a cross-legged sitting posture.

"A young crest; it is well," remarked Thefshath, scanning Thisk-Essif with an appraising eye. "Ishfenferath's loss shall be our increase."

"Where is this City of Exiles?" demanded Thisk-Essif. "I saw no city, from the air."

"It is within the mountain," Thefshath replied. "It was blasted out of the rock by our forefathers, when the power of the Hathetsi overspread the earth. In those ancient times all the desert yonder bloomed like a garden, there was no wall around Ishfenferath, and the Ispznossi were few and timorous. Of the exterior structures of the city, all save a few are now overwhelmed by the forest."

"Why did not the pilot from Ishfenferath bring me here directly in his own

machine?" Thisk-Essif now inquired. "I am told that there is a conspiracy between the air-pilots and the Exiles."

"A logical question," observed Thefshath, "but the answer is simple. The distance is great, and the pilots are under strict orders not to expend power wastefully. The unusual length of time required for such flights would be noted at Ishfenferath, there would be an investigation, and the Ten would learn of the City of Exiles before we are ready. Not all the pilots are parties to the conspiracy; many do not know that it exists."

"And what is this talk of 'speaking through the air'? How is that possible? And why do the Ten not know of it?"

"They are familiar with the theory and use of the apparatus, but have no practical knowledge of its construction. We communicate with Ishfenferath on a special wave-band—but that is meaningless to you. You shall be instructed in these matters."

"Another thought occurs to me. Why do the Ten send outcasts into the desert, intending them to perish, when it would be much simpler to slay them immediately?"

"The Ten live in an inner world of contemplation and reverie. They evade unpleasant facts, blunt words, positive action, violence. By banishing an outcast, they avoid the repugnant thought of an actual execution and can more readily forget the entire affair. But they cannot continue to solve their difficulties forever by ignoring them."

"SCATTERED over the face of the earth are the empty shells of cities which once were great and teeming with the Hathestsi. Now they are dead and tenantless, or are mere filthy dens of the Ispznossi. Storm and earthquake and the roots of jungle growths are reducing them to heaps of rubble. The ruthless hands of the Ispznossi tear them apart—stone by stone and generation

after generation—in their search for metal and glass wherewith to fashion their own clumsy implements. Throughout the world there are but two inhabited cities of the Hathestsi—Ishfenferath, and here.

"Some of those dead cities stand like islands along coasts where the land has sunk. Others of the more recently abandoned ones contain much which we have found useful. We have flown far and wide, and have ransacked those abodes of desolation for apparatus and materials which as yet we cannot make for ourselves. We have learned much from certain old Halls of Archives—which the Ispznossi avoid because they are sometimes haunted by strange sights and sounds. And everywhere we found ourselves preceded by expeditions sent out by the Ten from Ishfenferath. The Ten also are looting the world in their efforts to eke out their failing resources. They are living on the achievements of the past, and even that resource is beginning to fail them."

"The time is not far in the future when the last power-machine in Ishfenferath will falter and die, when the last reservoir of energy will be exhausted, and the Ten can evade the day of reckoning no longer. Then the great weapons of the outer defenses will be mere inert masses of metal and Ishfenferath will fall an easy prey to the gathering hordes of the Ispznossi, and they in their turn—"

Another crackling volley, nearer now, roused a swarm of rattling echoes in the mountains. Thefshath paused and peered through the glassy roof at the upward crags of the precipice.

"Ishfenferath will fall to the Ispznossi," added Visth, "unless the Exiles are many enough, and wise enough, and sufficiently equipped, to prevent it."

"Precisely. That is our whole aim and purpose," affirmed Thefshath. "And I might add—unless we are not discov-

ered before then by the Ten."

"Do you think that the Ten would—" began Thisk-Essif.

"They would annihilate us as soon as they understood our intentions," declared Thefshath. "Either we or the Ten must be masters of Ishfenferath. I understand them too well to hope otherwise. They would be driven to violence as a matter of self-preservation."

"Self-preservation!" exclaimed Thisk-Essif, aghast. "Do you mean—"

"I understand your feelings perfectly," said Thefshath. "You are hostile to the Ten, but one cannot overcome years of training in a few days. You have had it deeply instilled that the Hathests are beings of an almost unearthly nature. Even I, who am the last of the outcasts who first came to this place, two hundred and forty-odd seasons ago, have not wholly freed myself from that irrational feeling. But we must face the facts. Either the Ten must die at the hands of the Exiles, or the whole race of the Hathests will die at the hands of the Ispznossi."

A third volley resounded sharply, overhead, and rock-fragments fell on the roof of the solarium. The fragments shattered on the transparent material but the roof remained intact.

"The hunters are returning," remarked Visth, and the margin of her ruff curled slightly with amusement.

A horde of juvenile saurians was descending the precipice with the nimbleness of monkeys. They were as green as grasshoppers—a luminous, verdant green. All were equipped with ammunition belts and bore weapons whose barrels were nearly as long as the smaller individuals who carried them. The pack was pursuing a pair of small black creatures which were clambering down the precipice with frantic speed. One of the two was shot and picked up by its pursuers. The other ran out on a nearby shelf of rock, so that the con-

cluding events of the hunt were clearly seen by Thisk-Essif and the others.

The hunted thing was a shaggy, black, lemuroid creature with ludicrously large ears and bulging eyes. Its mouth was set in a stiff grin of terror, exposing huge incisor teeth. It ran to the edge of the shelf, found that it could not climb down because of the overhand, uttered a despairing squeak, clasped its forepaws over its head in frenzied indecision. Thisk-Essif was intrigued to note that its paws were in fact small, sooty-black hands. It turned, faced its pursuers, gathered itself together to spring.

"It is mine!" hissed the foremost of the young saurians. "Let me kill it!" Came the crack of a single shot, and the hairy black body somersaulted over the edge of the shelf. The young saurians continued on down the precipice by devious ways.

"What a repulsive beast!" shuddered Thisk-Essif. "It appeared to be covered with black fungus!"

"THAT WAS a *fesp*," Thefshath informed him. "They are indeed an alien sort of creature—an aberrant life-form. Their bodies are normally in a state of perpetual fever, and are covered with the curious fungiform modification of scales which you noted. They have evolved a strange process of internal incubation. And they are an even greater menace than the Ispznossi."

"They are the one thing which the Ispznossi truly fear," said Visth. "They are eaters of everything, they burrow in the earth, and they come forth by night. It is for fear of the *fespsi* that the Ispznossi build platforms for their eggs, and surround their nocturnal camps with rings of fire."

"Our forefathers held them in check with trap and poison," continued Thefshath. "Now they swarm everywhere and cause great havoc; the Ten have

closed their eyes to this danger also. They are of great interest to our student anatomists. But you must be instructed in many things; you must study and labor, and find your place among the Exiles. Visth will see that such provisions are made for your welfare as we are able to offer, and that you are placed with suitable instructors."

"I myself shall commence his instructions," declared Visth.

"So be it," concluded Theshath, and resumed his attitude of sphinxlike cogitation.

The tourmaline slab was filled with a rippling flow as of some pellucid blue liquid, shot through with bursting stars and arrows of light, and from it proceeded the reptilian accents of Thisk-Essif, saying simply, "Time passes, five-and-forty seasons."

A strangely effulgent moon, a globe of pallid incandescence, swam in a sky of scudding clouds. Scores of the Exiles were congregated at the low parapet along the precipitous southern rim of the air field. Their glossy bodies gleamed like watered silk under the full moonlight, or went black in the semi-darkness of a passing cloud. All eyes were turned southward toward Ishfenferath, where the desert plain lay under a heaving blanket of mist dappled with the moving blots of cloud-shadows. A few widely scattered beacons of sultry red, shining foggily through the mist, marked the fire-ringed camps of the Ispznossi. Sheet-lightning leaped and flared in the heavens, and the night was heavy with the dull, interminable cannonading of thunder.

In every group along the parapet there were individuals who scrutinized the southern horizon through binoculars—oddly constructed to conform to the divergent placement of saurian eyes. One such group had collected around

Thisk-Essif, who was busy with a larger instrument mounted on a tripod. A boxlike field telephone, emitting a faint glow from various apertures, stood on the parapet near him; it was connected by a flexible cable to the switchboard and radio room in a cavern under the air field.

"We cannot be sure that the flashes which we saw came from Ishfenferath," said Thisk-Essif. "They may have been no more than the lightning of a heavy storm in that direction. They were too rapid for me to obtain even an approximate reading of the distance—and if they were at Ishfenferath, they were beyond the range of this instrument. I await some word from the observers on the mountain heights."

"What has happened at Ishfenferath?" asked a newcomer. "I have just returned from duty at the sunpower plant. Is it true that we can no longer communicate?"

"The air-voice spoke from Ishfenferath shortly after darkness had fallen," replied Visth, who stood near Thisk-Essif. "It said, 'It is now or never. Do not act until—' Then it ceased in mid-sentence, and nothing has come through since then."

A little dot of light blinked on the telephone box and a metallic hissing issued from the device.

"Your observer is reporting from the peak above the copper mine," hissed the field phone. "A bright red glow on the horizon is clearly visible from here, and our triangulation shows without doubt that it emanates from a source at Ishfenferath. Analysis of the light indicates a discharge of heated gas and metallic vapor."

"Remain at your posts and report anything further which you may see," ordered Thisk-Essif. A few moments elapsed, then the light blinked again and another voice spoke.

"The detectors have picked up the

sound of an air-machine," said this second voice. "There seems to be but one. It has an electric drive and is approaching from a little east of south. I have given the necessary orders."

From the heights above the air field a score of light-beams probed into the sky, and on the slopes below the parapet hooded lights glowed and revealed a far-flung battery of projectors, their sleek sides gleaming darkly. A searching beam discovered the plane, a little silver toy in its brilliance. The other beams pounced upon it, and the ugly snouts of the projectors swiveled about toward it.

"The pilot is speaking through the air," said Thisk-Essif's radio operator through the field telephone. "I shall cut you in."

Crackling and whistling sounds followed, mingled with an indistinct saurian sibilation.

"... *fugitive from Ishfenferath*," came the faint hiss of the pilot. "*You could blast me from the air with ease, but I pray your permission to land.*"

"Allow the machine to land, but stand by your weapons," was Thisk-Essif's decision.

A glaring flood of light revealed every detail of the saffron-yellow machine as it dropped down upon the air field and alighted clumsily. The pilot emerged, and a seething hiss of wonderment arose from the onlookers.

"A Hathest! A Wise One! Have the Ten cast out one of their own kind?"

THE NEW ARRIVAL advanced slowly, with a distinct limp. Its open hands were extended, palms upward, and the long, almost tentacular, fingers were outspread, as a token of pacific intentions. One forearm was bound round with surgical dressings.

"I come as a fellow outcast," announced the Hathest haltingly, with labored breathing. "I am Apst-Pseps—not one of the Ten, but a neophyte

who would have become one of their number in due time. I was so unwise as to suggest that the Ten are ill-advised in punishing all opposition with banishment, and was myself sentenced to that fate."

Apst-Pseps paused, panting with palpitating throat and heaving sides.

"When the Ten announced my sentence it was followed by an insurrection among the air-pilots," Apst-Pseps continued. "At least half of them have been awaiting an opportune time for rebellion. They gave me this air-machine and told me of your City of Exiles. I request that no one enter it until I have removed certain articles which I was able to bring with me."

"The Hathest locked the door of the cabin; I saw it," hissed Visth softly behind Thisk-Essif.

"But what has happened since then?" Thisk-Essif inquired. "There is a glow in the sky as of a great burning in Ishfenferath, and the air-voice has been silenced."

"You know nothing of what has happened?" queried Apst-Pseps.

"Nothing whatever."

"Then I shall inform you. The rebel pilots covered my escape. They seized the outer defenses and turned the projectors against the city, threatening to beam the dwelling of the Ten. They did beam certain other structures and, probably by accident, destroyed the Air Communication Tower. The Ten ordered the generators to be shut off which were supplying power to the projectors, and one generator was wrecked by an inexperienced operator. The result was an outburst of uncontrolled disintegration which may not subside for many days. A section of the city collapsed into the resulting crater, which is still erupting. Therafter the rebels fled in their machines, pursued by the loyal pilots. More than that I cannot say, as I was concerned with my own escape. Now if you will clear the field, I shall

run my machine into one of yonder cave-shelters."

But when Apst-Psesp had reentered the plane it did not approach the hangars. Instead, it took to the air and vanished into the night. For some moments the throng around the air field listened in bewilderment to the receding drone of the motors. The searching light-beams tardily swept the sky but revealed nothing. Then Thisk-Essif's field telephone was again cut in on a message emanating from the Hathest.

"It is never wise to underestimate the intelligence or resources of an enemy," said the voice of Apst-Psesp. "I am now flying in the shelter of a mountain ridge where I am safe from the beams of your projectors. When I return I shall be at an altitude beyond their range and can unload my cargo of bombs at leisure. The tale which I told was true only in part. I was unaware that your city was so near when you discovered my approach, and I dared not risk an attempted escape at such short range. Therefore I acted as I did. You may console yourselves with the fact that my bombs are filled with a gas which is instantly fatal, as well as—"

The voice of the Hathest seemed to choke, and ceased.

"Direction of signals is almost due northeast," announced the radio operator via the telephone.

"Behold the wisdom of Apst-Psesp!" jeered Thisk-Essif. "Why does he not heed his own advice? Does the thick-headed braggart imagine that we shall tamely await the massacre? Let every combat machine take wing!"

The restless light-beams formed the patterns of a huge funnel-shaped basket against the stormy sky, and the war-planes of the Exiles rose into the air like a swarm of angry hornets.

"Three machines report they have sighted the Hathest," said the voice of the radio operator. "The Wise One's machine is flying erratically and has

turned southeast. I cannot hear our flyers clearly; the air is full of storm-interference. They have made some strange discovery regarding the Hathest's machine. It is now over the desert—and it is discharging its bombs!"

Far to the southeast a succession of murky yellow flashes traced a dotted line of light across the desert. Some seconds later came the sullen thudding sequence of the explosions.

"The Hathest's machine is completely surrounded," came the telephonic report. "It is returning to the air field. Apst-Psesp is being brought back alive. That is all."

WHEN Apst-Psesp's yellow plane descended on the landing field in the midst of its captors, a surging crowd of saurians closed in about it under the flood-lights. The Hathest's bulky form hopped forth with strange alacrity. The muzzle of a neutron gun came after it through the cabin door, pressed into the middle of its back. And at the other end of the gun was a diminutive young saurian, his juvenile green crest inflated with elation.

Apst-Psesp seethed and simmered with rage.

"To think that I, Apst-Psesp, should be compelled to suffer this shame!" rasped the Hathest. "To think that I should be so humbled by this vile nothing, this eggling, this spawn of a worm!"

"Tell us, Viskif, how did this come to pass?" demanded Thisk-Essif.

"The Wise One said that it had brought something from Ishfenferath," explained the youngster. "I wanted to see, but the door was locked, so I crawled through the air vent. There was a bomb-rack inside, full of bombs. While I was looking to see if there might be other things, Apst-Psesp entered very quickly and flew away. It did not see me in the darkness. I did not know what to do, so I said nothing. Then Apst-Psesp spoke through the air

and I understood what it intended. I put my gun against its fat back and it was very much surprised. I told the Hathest what should be done with the bombs, and it was done. Then I heard our machines following, and I ordered the Hathest to allow me to speak to them through the air. Then we came back here. The Hathest is my prisoner. Shall I kill it?"

"Not yet. There is something I would say," replied Thisk-Essif.

"Not yet!" repeated Apst-Pseps in consternation. "What talk is this? Do you presume to threaten the person of one so infinitely superior to yourself?"

"Apst-Pseps, by your own words you brand yourself an ignorant egotist," declared Thisk-Essif slowly. "You betray an utter failure to comprehend the spirit and purpose of the Exiles. You refer to us as a spawn of worms, when in truth we are the last hope of our race. You will never understand that there is no life without growth, and no growth without the penalty of stress and change. You should welcome the transition to a state where stress and change shall trouble you no more. The Ispznossi shall be my agents in effecting this transition. I consign you to whatever fate may await a solitary unarmed-Hathest in the desert wilderness."

"You are thinking only of revenge," admonished Visth. "Apst-Pseps in the desert among the Ispznossi would be of no further use to us. But there are poisons which slay quickly and painlessly, with almost no damage to the tissues—and our anatomists have long desired the opportunity to dissect the body of a Hathest."

For a full minute after Visth had spoken there was a stony silence, broken only by a far-off roll of thunder and the croaking of a flight of nocturnal pterodactyls which flapped across the face of the moon. Apst-Pseps looked wildly at the coldly accusing eyes of the Exiles

who surrounded him, saw them fingering their hand weapons suggestively, and then seemed to wilt. The silence continued as the Hathest endeavored to speak but uttered only a strangled gurgling.

"It may be that Apst-Pseps alive would be of even more value than as an anatomical specimen," remarked Thisk-Essif at length. "It may be that in return for his life the Repository of Wisdom will deign to answer our inquiries truly."

"I shall tell you anything . . . anything!" vowed the Hathest feebly.

"Very well. Then tell us what has happened at Ishfenferath."

"I am one of the Ten, and no neophyte. We discovered the conspiracy among the air-pilots and the rebels turned the projectors against the city, as I have said. The loyal informer disclosed the secret chamber of the Air Communicator wherewith the conspirators spoke to the City of the Exiles, and the operators were slain. The Communication Tower was destroyed as I have told you. We became suspicious even of the loyal pilots and placed them all in confinement, for questioning. The rebels are still at large, we know not where. Since we trusted none of the pilots who remained, and since I alone among the Ten can navigate an air-machine, I was delegated to destroy you. I hoped to approach unseen in the darkness but you discovered me while I supposed that your city was yet far away. We have told the people of Ishfenferath that the Exiles intend to conquer and enslave them. If your machines approach the city now they will be blasted on sight. Three-fourths of the projectors are still functioning."

"Undoubtedly the rebels will come here by a circuitous route and join forces with us," mused Thisk-Essif. "And for the present we can no longer speak to Ishfenferath by air. But there is another means whereby we can make

known our true intentions and undo the mischief of your falsehoods. We have your air-machine, which can return to the city unchallenged. I shall prepare a message, Apst-Pseps, and you shall be our courier. One of us shall accompany you to see that you do not betray us. I would go myself, but I am needed here.

"You are fortunate that your fate is in my hands and not in those of Thefshath, who was once our leader. He would have shown scant mercy toward the treachery of a Hathest. The stress of his labors in the service of the Exiles took him from us before his time, and his material remains have basked for many seasons upon their slab on the Mountains of the Sun."

"HERE ENDS my sequence of objectivized memory-images," Thisk-Essif announced. "My words now come to you as a direct recording."

He stood in the cliff-cavern which had been the library and work room of Thefshath, illumined from above by a vivid spotlight. About him was a crowded accumulation of intricate paraphernalia—the loot from the archives of a score of dead cities of the Hathests. Some unseen small mechanism filled the air with a ringing hum. Behind him a broad archway looked outward through the solarium upon a sky of mountainous thunderclouds—their bases steeped in deep blue shadow, their summits flaming with the furious golden-reds and burning pinks of a Mesozoic dawn.

"It is my hope," continued Thisk-Essif, "that this pictured narrative will convey to the people of Ishfenferath, more vividly than any barren recital of facts might have conveyed, the nature of the perils which gather about us and the purposes of the Exiles. There was a time when the Ten were not the Ten, but the Ten Thousand—the directors and coordinators of all the creative labors of our race, all long forgotten.

If the Exiles are permitted to return, the present Hathests will be remembered long after their spirits have returned to their home in the Sun—as the Ten Wise Ones who were wise enough to share their powers with us. If we are not permitted, then Ishfenferath shortly will become a war-blasted heap of wreckage, and neither it nor the Ten Wise Ones nor the Exiles will be remembered by any save the Ispznossi—who also go in fear of another doom which creeps upon them in the darkness. I have labored through the night on the preparation of this message, using a device salvaged from a city dead beyond memory. It may be that what I have produced is the preface of an endless chronicle of future greatness. Or—according to the nature of your choice—it may be no more than the valedictory of the Hathests."

A multitude of small dark objects, like a flight of pterodactyls, began to stream across the background of flame-hued thunderclouds, and Thisk-Essif was interrupted by the entrance of Visth, Apst-Pseps, and others.

"A fleet of air-machines draws near," said Visth rapidly. "We have tried to contact them but they do not answer."

"The rebel pilots! They have arrived at last!" exclaimed Thisk-Essif, and the entire company hurried into the solarium. The recording apparatus hummed on, temporarily forgotten.

"They are an unfamiliar type of machine," Thisk-Essif announced after scanning the fleet. Apst-Pseps suddenly uttered a long hiss of dismay.

"Those are not the machines of the rebels!" declared the Hathest. "They are pilotless machines, controlled by another far in the rear. Each one is a huge flying bomb!"

"Then it seems that your colleagues decided not to await your return, and are not averse to annihilating you along with the rest of us!"

"Treachery!" hissed Apst-Pseps.

"There may be safety in the deeper caverns of your city! Show me the way!"

A chorus of sirenlike howls arose as the beams of the Exiles' projectors cleft the protesting air, and a distant plane vanished in a cauliflower-head of dense yellow smoke. The following detonation shook the ground and sent a rock-slide rumbling down the precipice.

"This recording must be taken to a place of safety until we have fought off these machines," said Thisk-Essif, re-entering from the solarium. "The tablet is impervious to water and would be protected from gas-corrosion if we sank it in—"

PRESUMABLY the recording device was shut off a few moments later, but the concluding words were never heard by the four watchers in Penstone's cave. The flue in which the tourmaline slab was embedded had been growing steadily hotter and hotter, and now the complex fabric of artificial internal stresses which had been impressed upon the slab began to give away. It seemed that Thisk-Essif and all those with him on the threshold of the solarium were overwhelmed in a wave of intersecting streaks of fire as the slab split and cracked along numberless planes of cleavage. It burst into a shower of frag-

ments which cascaded down over the mantel and fell tinkling upon the hearthstone in a bristling, disorderly heap.

Penstone and his three friends remained for a time in a semi-cataleptic state; then their benumbed minds returned slowly to independent functioning. Later they would entertain doubts, they would engage in endless controversy, but for the moment they did not doubt the authenticity of what they had experience.

"Fifty million years ago, more or less," murmured Elza, "a great civilization rose and fell."

"Thisk-Essif's message didn't arrive," Penstone remarked hoarsely. "Or if it did, it didn't do any good. It just wasn't in the cards."

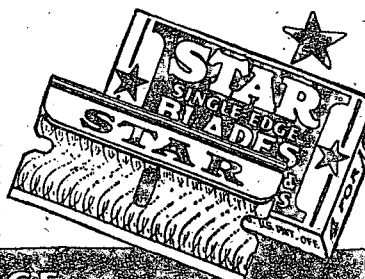
"If it had accomplished what he hoped, where would we be now?" muttered Ormrod. "House pets of super-saurians! Or would we? The Hahstesi went up the same blind alley as the bees and the termites, and fared worse."

But Mosgrove said nothing for a time. He was gazing at the heap of fragments on the hearthstone, silhouetted against a background of fire. To his professional eye, which saw architectural forms in everything, it was the ruins of Ishfenferath, black and jagged against a bloody sunset.



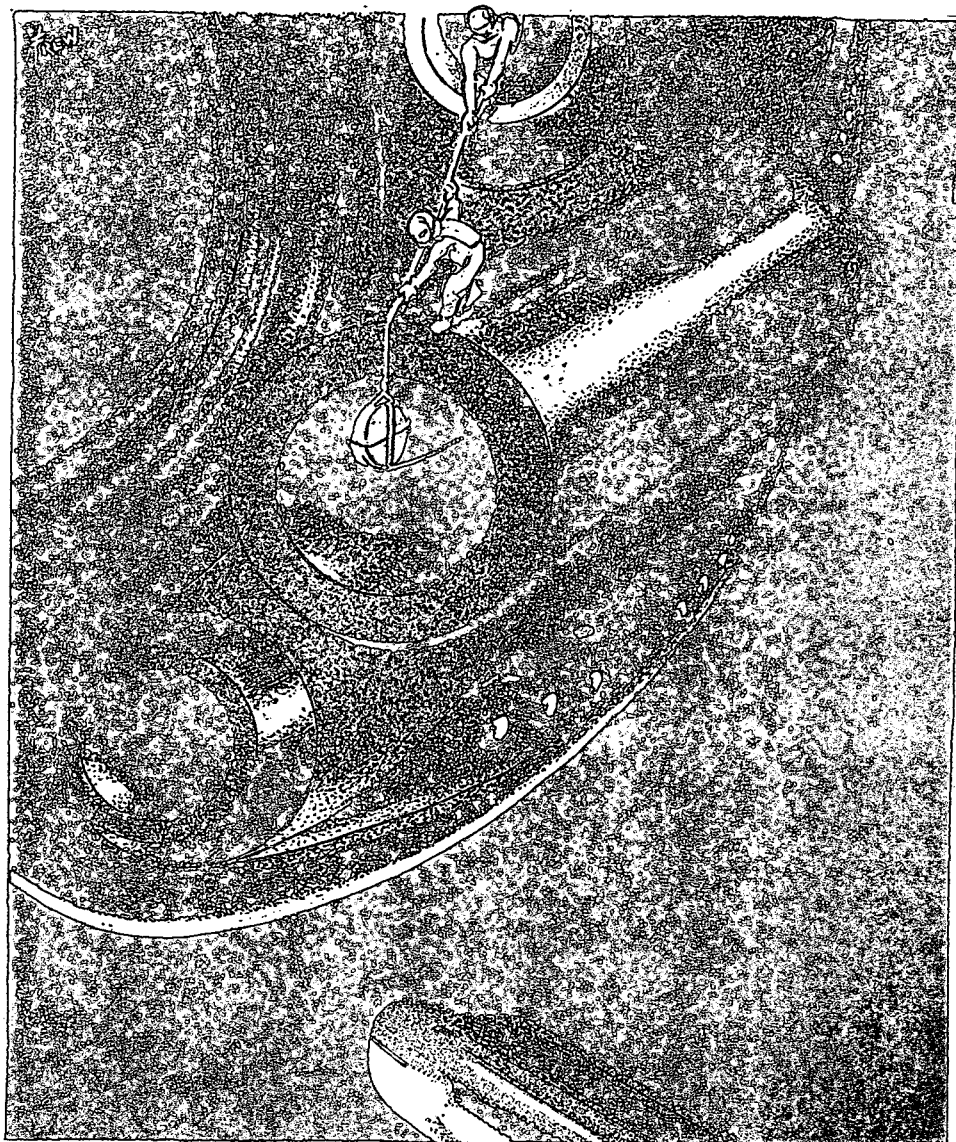
WHAT HAPPENED TO CROSS-PATCH?

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MAIDEN VOYAGE



by VIC PHILLIPS

AST-4

Maiden Voyage

Trouble starts when a commercial man makes a military invention—and doesn't know it!

KARN JONES was a commercial liner man, a straight-bar man, at that—provisional commander, that is—and he missed up on a point when he installed his instantaneous reaction control in the gravity screen generator leads on the brand-new *ITS 457*. Physically—engineeringly—the installation was perfect. Therein lay the fault, for Karn Jones was a commercial liner man, and he had no interest whatever in the military needs and defenses of the Interplanetary Patrol.

Interplanetary Transport, when they built the *ITS 457*, knew they'd need a man absolutely familiar with her every bolt and telron girder to command her. She'd spent three years in the building, and they wanted her commander to grow up with her.

But Jones had ideas. He loved that ship-to-be when the first huge tubes of the central core were placed. He watched the thousand-foot fabric of her—the biggest Interplanetary or any other line had ever laid down—grow about the telron beams of the engine-room core. And he didn't want—ever—to see the wreckage a meteor could make of that glistening fabric. He installed his gadget in the gravity screen generator leads.

Now a military ship, being designed to take a beating and like it, and for no other purpose, can carry immense gravity screen generators. No meteor can penetrate the field they throw around the ship's hull. But a commercial ship must carry payload; they carry screen generators, of course, but not the mass of them a military ship can afford. Karn installed a simple little relay control,

a very small gravity screen generator that would react practically at the speed of light, and hooked his apparatus in the main leads from the really huge gravity screen generator a thousand-foot hull had to carry for even mild protection. His idea was that any meteor touching the very weak little field the small generator threw out would automatically throw the entire, massed power of the huge main generator against that particular sector whence the attack came. When you concentrate the field that will fairly adequately shield 2,000,000 square feet of surface on an area of only 500 square feet of actual danger zone, even light quanta are slowed to a practical crawl. Meteors, Karn Jones rightly calculated, would *not* get through.

Being a commercial liner man, his thought was satisfied there. The mighty *ITS 457* went out on her trial flights and handled with the responsiveness of his own hand. Karn found two meteors, but it wasn't test enough to suit his taste, so he made his tactical error. He cruised over toward the Military Danger Sector, hunted up a patrol commander out on test mission, and suggested that the patrol try out one of the new Verdun torpedoes. The Verduns were specially designed to penetrate the gravity screen of a military ship and remove that ship from existence. The patrol commander had a certain hesitancy in complying with the request to use a magnificent new liner as a target, but he was piqued at the idea that a mere commercial ship should suggest a Verdun *wouldn't* go through, so he eased one of the torpedoes over at quarter throttle.

It stopped dead at the outer fringe of the *457's* screen, and the report indicator on the military ship howled in anguish. The patrol commander backed that torpedo out and shot it in again at full throttle. The report indicator moaned once and quit, indicating a field

intensity that didn't, to the best military knowledge, exist, and the Verdun's controls went sour completely.

"Thanks," radioed Jones, "I guess they don't penetrate," and went away. Not being a military man, but a commercial liner man, he didn't realize the patrol's silence was due to frantic efforts to regain control of or destroy the wild Verdun torpedo, which was specially designed to be extremely hard to destroy or capture. And he had to get back because the 457 started on her maiden voyage in thirty-six hours—which was sooner than military reports could be passed along, believed, and acted on. Karn Jones was anxious to get started on that trip, for at the end of the first leg of this Three Point Line journey—Earth-Mars-Venus—the inspector at Mars Base would complete that straight-bar provisional commander's insignia to the bar and circle of the permanent commander.

There would, of course, be a complete inspection of himself and his ship, but Karn wasn't worrying about that. Practically the whole twenty-seven years of his life had been directed to this end with a singleness of purpose that made him now the youngest commander ever to be commissioned. He knew every inch of the ship from nose plate to exhaust tube, and he was completely trained to take over the job of any one of the hundred and fifty members of his crew, including the normal functions of the medical officer. He had to be, for while the ship was in flight, he was the final court of appeal for anything that concerned it. He had to be prepared to act as judge, jury and, if necessary, executioner. That was the meaning of that single bar on his cap, and he was fully determined to add the final accolade of the circle. The ship and crew were a functioning whole, now, after six months of test flight that had preceded that final, insolent defiance of the Verdun torpedo.

TWO THIRDS of the trip lay behind before Karn Jones got a hint of the trouble any military man could have told him was inevitable. Everything was beautifully smooth, till then, and he felt himself already wearing the completed insignia. There was one aspect of his position, however, that he had not counted on, and it was becoming more and more apparent as this flight progressed. It was the complete social isolation of the commander on board a liner. During the tests, Karn and the other members of the crew had been fellow experimenters proving a new piece of equipment in which they all had an interest, but here, on the regular commercial run, they were crew and he was captain, and he and they both knew it. This was one installment of the price of leadership that he had not before encountered. It probably explains why he relaxed one of the minor rules of operation and allowed two of the passengers into the control room during flight.

Besides, he was practically acquainted with one of them, for Michael van Dorne was almost a legend along the spaceways. Thirty Earth-years ago, this short, powerfully built human had stepped into the first experimental spaceship to be powered with the original, primitive version of the atomic blast that drove the mighty 457. His take-off had been to the accompaniment of skeptical prognostications that if he returned to Earth at all, it would be in the form of a cloud of fine dust. He returned, however, to confound the skeptics, and furthermore he made the round trip to Venus and return in about one tenth the time required by the old liquid-fuel rockets. Since then, the trail of his exhaust flame had burned across most of the empty spaces in the Solar System, so it was with considerable respect that Karn spoke to this greatest of all the hardy brotherhood of the space lanes. It was somewhat of a relief to converse with

someone who didn't "yes, sir," at every opportunity.

The second passenger was Michael van Dorne's daughter. If Van Dorne's reputation could be considered sufficient excuse for the relaxation of a minor rule of operation, the appearance of his daughter was quite adequate reason for scrapping the whole code. Her head came only up to Karn's chin, which was not surprising, for Commander Karn stood six feet two. Her name was Gilda, and she was a perfect representative of an almost forgotten type of Dutch beauty. It wasn't a flaxen type, for her hair was a rich gold and her eyebrows darker, her eyes were dark-blue and apparently bottomless. She looked utterly yielding, inviting and helpless—which was a darned lie. Her father knew from long experience that she was entirely self-sufficient, the soft curves of her body were built of perfectly trained muscles. She was as good a mechanic as he, and very nearly his equal as a pilot.

Unfortunately, Karn didn't know this and took her at face value. His intensive training for his present position had left him little opportunity to gain much experience along other lines, so he jumped to the conclusion, born of ignorance, that anyone so beautiful probably wasn't any super intelligence. She wouldn't need to be, he reasoned. He explained features of the ship in simple language for her benefit. Condescendingly, he talked down to her and adopted a slightly patronizing air. Gilda was genuinely interested in the operation of the super-liner, as any experienced pilot would be, but Karn's steady refusal to consider her capable of taking an intelligent interest in the mechanics of its operation was rapidly driving her into a state of quiet fury.

A situation was developing. Gilda was quite well aware of her unusual beauty, but she didn't want any special consideration on that score. She hadn't

been responsible for it, anyway. What she was proud of was her skill and experience as a pilot, and this big ape who had somehow finagled himself into the position of commander of this really interesting liner was treating her as though she were just another beautiful dunib deb who knew nothing more of the three planets than the locations of their principal entertainment centers.

Van Dorne knew an explosion was imminent, but made no effort to head it off. Karn had made an error in judgment, and Gilda would probably correct it more quickly and effectively than anyone else could.

THEY WERE standing in front of the viewpanel of the ship's alarm system, while Karn was breaking down a description of the alarm system's operation into simple language for Gilda's benefit, quite oblivious to her restrained quietness. Gilda was busily brewing a vial of subtle sarcasm as a contribution to Karn's further education when the alarm system took things into its own hands and put on a very convincing display of its effectiveness.

There was a series of sharp, peculiarly penetrating beeps, an intensely irritating flutter of light, and an acrid, tingling nasal sensation. That alarm system was taking no chance of being ignored. The viewpanel suddenly blazed intolerable light, that died swiftly. There remained a writhing, swirling, formless movement. Karn's mind involuntarily ran through a rapid checking of things that could go wrong with the alarm system to make it act like this. Then the viewplate cleared and revealed the system to be working as it should.

Karn hardly recognized the section of the ship pictured on the alarm screen. It was the corridor running along the right side of the atomic drive housing. Only someone as familiar with every plate and welded seam of the ship as Karn was could have recognized the

madly tangled wreckage. He could hardly believe his eyes; that mess of tortured metal couldn't be any part of his ship. But as the swirling smoke dwindled and streamed off to the nearest air-conditioning intake, his eyes insisted and he had to accept the existence of what he had believed impossible. No. 4 service port in the massive telron housing had blown out.

He just stared dumbly at the smoothly seared round hole pictured on the viewplate. That housing was built ten times over strength, and the service ports were further reinforced; they couldn't have failed. The drifting smoke was nearly all gone now, and the screen almost clear. There was something in the lower corner on the floor. Even as Karn's hands shifted the scene to get a clearer view, his mind, automatically checking the routine of the ship, came up with the information that the chief of maintenance should have been somewhere near No. 4 port on his inspection round. He knew what he would see before the changed scene came sharply into focus. Most of the maintenance chief lay sprawled on the heat-warped floor plates. His head and one shoulder were gone. A thin trail of smoke still drifted from the headless remains. The annihilating atom flame must have caught him just as he was passing the port. Karn felt a little sick; that burst of flame could have lasted only a minute fraction of a second before the emergency controls stalled the atomic drive. The only sound in the control cabin was the quiet chuckle of the banked circuit breakers as they shuttled back and forth, automatically adjusting the gravity fields to their lack of acceleration.

II.

TO KARN it seemed that ages had passed from the first sharp beep of the alarm system, but it was only a small group of seconds. In that brief moment,

his whole world had shifted and changed. The impossible had happened; the 457, mightiest and fastest ship ever to burn its trail of speed across space, had been blasted in one small, searing jet of atomic flame from a responsive, almost live thing into a helpless derelict that was slowly drifting around the Sun. He stood for a few seconds stunned into immobility, then the reflexes of his long training took over.

The passengers first. That was rule one of the operating code. His hands on the controls of the viewpanel shifted the scene rapidly from deck to deck of the great liner, while his eyes searched intently for any hint of panic. Everything was all right there; the passengers placidly pursued their infinitely varied activities, apparently unaware that anything was wrong.

Report to headquarters next. He shifted the scene to the cabin of the communications officer, switched in the voice circuit and had his mouth already open to speak before he noticed anything wrong. The small, bare room with its banks of switches, dials and viewplates appeared quite normal, but a second glance revealed that every vital switch and indicator dial had been systematically wrecked. The communications officer was apparently asleep, with his head on his folded arms, as he sat at his master control desk. Then a cold chill seemed to clamp down on Karn as he saw the thin sliver of steel that thrust upward from between the slumped shoulders. The glint of that fragment of metal lined up events in a new and grimly sinister light. There was murder in that room, an ancient, horrible type of murder that struck from behind with a knife. He heard Van Dorne grunt and Gilda's quick gasp. Now he knew the failure of No. 4 port had been no accident; there was treason aboard and anything was possible.

He switched off the screen, stepped

quickly to a heavily built telron metal cabinet and held his hand up in front of it. The cabinet contained the commander's portable atomic flame projector, which was the only weapon officially on board. The sensitized front panel of the cabinet responded only to the line pattern of Karn's hand, and in response it now slid smoothly down. As Karn reached for the projector, half the sleeve of his tunic vanished in a puff of smoke, a splutter of crackling sparks burst in front of him as the tip of an atom flame passed his arm and burned against the impervious telron of the cabinet.

"Don't touch it," a voice commanded, and Karn's hand froze in midair. "Turn around, slowly." Karn turned, slowly, and met the pale, cold eyes of Parr, the medical officer, over the top of projector sights. Behind him were half a dozen members of the crew armed with spanners, wrenches and other equipment from the maintenance department.

"Where did you get that projector and what do you want?" Karn demanded sharply and was surprised at the calmness of his voice. Inwardly he was all at sea—mutiny on the space lines! It just didn't happen.

"It came aboard in pieces, Commander Karn, and all I want is that other projector and this ship."

"You can't get away with that," Karn stated flatly. It was supposed to sound threatening, but Karn realized that with himself on the wrong end of a projector it was just silly.

"We seem to be doing all right up to now," Parr pointed out dryly. "Now get—" He tensed suddenly and moved the projector slightly to cover Gilda. She was swaying a little, then she sighed quietly and collapsed at Karn's feet.

Van Dorne made a move toward her.

"Stop!" Parr's voice snapped and he swung the projector. Van Dorne had had enough experience with men under nervous tension to do as he was told.

Parr was certainly under strain. He should be; anyone attempting to hijack a mainliner for whatever reason was taking some awfully long chances.

He kept the projector on Van Dorne. "Move over against the wall and lie down," he commanded. Van Dorne moved slowly to obey; Karn stood perfectly still and didn't move at all, because something else was moving at his feet. It was Gilda. Her hand crept cautiously over his foot and slid open the zipper down the front of his shoe.

WITH A SUDDEN flash of inspiration that wasn't entirely his own, Karn knew what to do. He wiggled his toes until the shoe loosened from his heel. Van Dorne was lying down slowly; Parr was half watching him as well as Karn; the muzzle of the projector wasn't directly on anyone. Karn kicked vigorously and the shoe flew past Parr's head. Parr jumped like a nervous cat, and ducked as he started to swing the projector on the flying menace. Out of the corner of his eye he saw Karn lunge toward him. The atom flame lashed out and swept down, then leaped wildly to the ceiling again as Van Dorne, leaping from a half-recumbent position, exploded under Parr's chin. The medical officer immediately resigned as ring-leader of the mutiny.

Karn grabbed the muzzle of the projector, as a swinging wrench knocked it out of his hand as the other half dozen mutineers rushed in a body. This was a tactical error, for in the resulting mêlée Karn punched, kicked and butted everything that came in reach with a wildly abandoned enthusiasm that stalled the putsch before it got properly started. The second maintenance officer saw what was wrong, and yelling to the others to stand aside, charge in swinging a three-foot spanner. He whirled it above his head, and then his head vanished in a spluttering burst of sparks and smoke. For a stunned mo-

ment before the corpse collapsed, nobody moved; the clang of the falling spanner was the signal that released them. Four of the mutineers leaped for the doorway. Three got through safely, but the projector flame caught the other one and he, finding it impossible to breathe with but half a lung, thereupon died. The door thudded against his remains and stayed half open.

Van Dorne lurched for the opening with the projector, started through, and went down as a wrench came hurtling along the passage and caught him between the eyes. Gilda was on her feet and help Karn drag her father back into the cabin. Karn boosted the remains of the dead mutineer out into the passage and slammed the door shut. Van Dorne groaned and started coming round as Karn turned from the door and Gilda stopped looking anxious. Karn stepped to the medicine chest and got the "wake-up" bottle with which every cabin was equipped. It was a cylinder containing a compressed concentrate of vitalizing gases. They were used in event the gravity fields failed, when the dizzy upsetting of balance usually dropped a good portion of the crew into unconsciousness. He held the nozzle under Van Dorne's nose and pressed the valve release that automatically doled out one dose.

The result was instantaneous. Van Dorne's eyes snapped open, he gasped, snorted, sat up, and tried to duck the wrench that apparently was still flying toward him. Then he winced as memory of its impact returned. He put his hand up to his injured nose and felt it tenderly. It had bled a little and was swelling up rapidly. It wouldn't be long before he had a glorious pair of shiners to accompany his enlarging proboscis. Having finished the inspection of his nose, he glanced at his daughter kneeling beside him and grunted.

"Well, you're still here. It can't be heaven." Then he cocked an eye up at

Commander Karn, who stood by, still holding the wake-up bottle. "Is this sort of thing part of your regular operating routine?" he demanded.

"No." Karn replied with slow seriousness. "It was entirely impromptu. I haven't the faintest idea what it's all about."

Van Dorne grunted something between a "hah" and a "huh," pulled his feet under him, and stood up with surprising quickness.

"That was a smart move, undoing this fellow's shoe," he conceded in Gilda's direction.

"It certainly was," Karn agreed earnestly, "and I want to apologize. I thought—" Then he stopped and reddened painfully as he realized that anything further he might add would only make it sound worse.

"Well, what did you think?" Van Dorne demanded. "You didn't think my daughter would be absolutely helpless, did you?"

"Or did you?" Gilda seconded sweetly.

Van Dorne turned to her. "Pipe down, daughter," he commanded. "This man's going to have enough trouble from here on without you riding him. All right, commander," he addressed Karn. "You've got a mutiny on your hands. What're you going to do about it?"

KARN DIDN'T answer; he was already doing. He dropped to his knees beside the mutineer who hadn't moved for the door. This one wore the uniform of the maintenance crew and lay flat on his back with his arms wide-spread. Karn held the nozzle of the wake-up bottle under his nose and pressed the valve release. There was no response; then Karn noticed a widening pool of blood spreading from under the mutineer's head. He turned the apparently lifeless form over on its side. The back of the head had evidently come into violent collision with

a wrench during Karn's brief battle with the invaders. He let the body fall back and stood up. That mutineer would never tell anyone what the mutiny was all about.

Karn's mouth was a little white at the edges. This slaughter was beginning to get on his nerves.

"Parr's going to talk," he said quietly and turned toward the recumbent figure of the medical officer. But Parr had been playing possum. He rolled over and was on his feet in one lithe move; he was at the door before Van Dorne swung the projector on him.

"Just wait awhile," Van Dorne advised. "Take him, Karn."

As Karn approached, Parr's pale eyes flicked quickly around the cabin, sizing up the situation. He saw there was no chance of escape; his hand went quickly to his mouth. Karn leaped and struck up his arm. Parr tried to say something, choked on the words and, with a sardonic grimace of pain, died in Karn's arms.

Karn dropped the lifeless body and stood back, shaking a little. He looked questioningly at the other two. Van Dorne shook his head and looked serious.

"It looks bad," he admitted. There was something subtly horrible about the whole affair. The fiendishly accurate timing of the failure of the service port to eliminate the chief of maintenance, the stealthy murder of the communications officer, the inhuman, mad-dog ferocity of the mutineers' attack culminating with the suicide of Parr.

"I guess the only thing to do is go out and investigate," said Karn and opened the door cautiously. A wrench handle hurtled past his head and crashed against the far wall. A heavy gauge block clanged solidly against the door as he closed it hastily.

"They're still with us," Van Dorne remarked.

"It looks like you'll have to crawl

out," Gilda suggested.

Karn blinked. "That's an idea," he agreed. "Let me have the projector." He addressed Van Dorne. Van Dorne handed it over; Karn lay down on the floor by the door. "Now open the door and keep behind it."

Van Dorne swung the door open. Immediately a shower of missiles swept over Karn and clanged and clattered against the wall and floor. The row was instantly followed by the spluttering crackle of the projector going into action. "There were seven or eight. I got two," Karn grunted as he scrambled to his feet and started down the passage.

"You stay here," Van Dorne threw in Gilda's direction. He picked up the wrench handle and a long spanner and started after Karn.

Karn was pressed against the left wall of the passage, trying to look down the right-hand corridor leading to the officers' quarters, without exposing himself to flying tools.

"Which way'd they go?" Van Dorne asked in a hoarse whisper.

Karn gestured to the right.

"Well, let's go after them," Van Dorne suggested belligerently.

KARN GLIMPSED the flicker of a hand raised to throw in the darkened corridor. He lifted the projector and fired in one motion. A bite of the corner wall flamed and vanished. The smoothly seared edges dripped molten droplets of fire. A scream tore from the corridor; Karn leaped around the corner on the heels of it. The projector slashed its spluttering flame into the gloom. There were two solid thuds as doors of the officers' quarters slammed shut. A sudden quick scuffle of feet and a sickening crunch came from behind. Karn spun round, holding the projector waist-high.

"He was in the other passage," Van Dorne explained calmly. "I got him," he added. He certainly had got him.

The wrench handle was bent and there was blood on it.

"I got one," said Karn, a little dully. "The one I hit in the arm. He was staggering all over the passage—I just burned him up." He licked his lips and swallowed. "I wonder what's got into them. They must be crazy to try anything like this."

"Crazy or not, they came pretty close to putting it over," said Van Dorne. "What's down this left passage?"

"The crew's quarters."

"Well, they evidently aren't in favor of a mutiny. These doors are welded shut."

Each cabin door was spot-welded shut in three or four places. The portable welding machine was still in the passage. Karn stepped into the passage and examined the welding.

"I guess anyone within is on our side," he concluded, throttled the projector down for short-range work, and had the door open in a few seconds. They swung the door inward cautiously. The cabin was dark and they could see nothing. Suddenly the lights flashed on and they stood blinking at three badly scared stewards who blinked back at them.

"Oh, it's you, commander," said one with almost comic relief and started a semi-falsetto laugh, then it choked off as his eyes fell on the projector in Karn's hands. He looked up at Karn; his eyes were scared. "W-w-what's the matter? We heard some one scream. Is anything—"

"No, nothing's wrong. We've just got a mutiny on board, that's all," Karn cut in grimly. There was a dead silence, and in that moment the stewards came fully awake.

"What do you want us to do, sir?" one of them asked quietly. Karn explained the situation quickly, and in a few moments had them equipped with lengths of steel cut from the bunks. They went with Van Dorne to make

sure that none of the mutineers escaped from the officers' quarters while Karn proceeded to the rest of the cabins along the passage.

In a few minutes the cross passages were crowded with all the crew who had been off duty. They were all armed with sections of bunk rails, except Harwood, the chief steward. He was the biggest man on board, and required something a little more substantial as a weapon. He had torn out a section of plumbing equipped with a T fitting on one end. He followed Karn back to the main passage now, his formidable mace sloped over his shoulder.

"All right," said Karn. "Harwood and you three." He detailed the three stewards who had been first released. "Come with me, and we'll clean out the first cabin. The rest of you don't crowd in—leave us room. Van Dorne, will you take charge out here and send us any assistance we need?"

"Sure, I will," Van Dorne agreed. He was still carrying the bent wrench.

"O. K., let's—"

"Dad!" It was Gilda, coming down the passage from the control cabin. With difficulty the crew remembered their manners and refrained from staring.

"What is it, daughter? I thought I told you—"

"There's something funny about Parr. I thing you'd better come and look," Gilda cut in.

III.

WHEN HIS daughter spoke like that Van Dorne didn't hesitate. He glanced at Karn. "I guess we better go look," he suggested, and started for the control cabin. Karn started to say something, then thought better of it.

"Take charge here, Harwood," he said to the chief steward. "Don't let any of them get out of there. I'll be back in a moment."

"If any of them do get out, they'll be somewhat oddly shaped," Harwood

promised and appreciatively hefted the weight of his bludgeon.

Karn strode quickly down the passage to the control cabin. Van Dorne was on his knees beside Parr. He was holding the dead medical officer's head by a handful of hair. He looked up as Karn entered.

"Come here," he said quickly, forestalling Karn's question. "Look," he instructed and pointed to the roots of Parr's hair. Karn bent and looked closely.

"I don't see anything, unless you mean that green at the roots," he said.

"If you see that, it's enough," said Van Dorne abruptly and let Parr's head drop. He drew a small case knife from the pocket of his tunic, pushed Parr's sleeve back, pinched up a ridge of flesh on his forearm and made a short incision. Blood oozed out slowly. Karn stared and bent quickly closer. The blood was an even, translucent green. Van Dorne let the sleeve slip down and they both stood up.

"What happened to him?" Karn asked in bewilderment.

"Nothing," said Van Dorne. "That's the normal color of his blood." There was a new hardness in his voice. "It means that you won't take any of these mutineers alive."

"How so?"

"Have you ever heard of the Lader-Kol?"

"I've heard something of it. It's a kind of lodge or something, I think; but what's that got to do with this?"

"He thinks it's a kind of lodge," Gilda informed nobody in particular. "Just a happy, peaceful murderers' club. Maybe he doesn't read anything but the funny papers. Perhaps—"

"Daughter, I'm telling this," Van Dorne roared.

"Yes, papa," said Gilda, viciously demure. She glared a handful of daggers at Karn, then dropped her eyes and closed her mouth firmly.

"The organization is more in the nature of a cult," Van Dorne began, keeping a wary eye on Gilda in case of more interruptions. "It's pretty old. It first came to public notice about a hundred and fifty years ago, but it may have been going long before that. The founder was a Dr. Lader, as far as is known. He is supposed to have discovered some method of prolonging life—some people claim he is still head of the cult. Part of their treatment for longevity includes changing the metal base of the blood from iron to copper. That's how come the green color of Parr's blood."

"What about these others? Their blood is normally red."

"They're probably recruits; they've likely been promised membership in the cult if they put this job across."

"Well, what the dickens would they want with a ship load of passengers?" Karn asked innocently.

A stern parental glance forestalled an explosion of sarcastic explanation from Gilda. "All right, dad, I know you're telling it. But of all the—" She let it go at that, walked across the cabin, picked the projector Parr had used and started to inspect it closely.

Karn didn't know he had been flushing hotly until he felt his cheeks cooling. "Now maybe you'll tell me what they would want with a shipload of passengers," he said determinedly.

Van Dorne muttered something about infants, then continued: "This Dr. Lader evidently didn't come by his knowledge of longevity easily. It seems he conducted a lot of his experiments on live humans, and not always with their consent. It was done in secret, of course, but fifty years ago, forty members of the cult were convicted of murder. They were all gassed, and the cult outlawed. People thought they had heard the last of it, but Dr. Lader wasn't found; in fact, all the members caught denied that there was any such person.

This is the first time they've showed up since then. I guess they want to do a little more experimenting. The passengers and crew of this ship would provide subjects enough for a long time."

"But what's the object of all their experimenting?"

"They're just goofy enough to think they can evolve a super-long-lived race who will eventually rule the Solar System."

KARN WAS impressed. "Don't you think we could persuade these mutineers to surrender?" he asked doubtfully.

"Not a chance," Van Dorne assured him. "The worst we can do to them is whittle them down slowly with the projector. We probably couldn't make the treatment last for more than half an hour or so. If they fail here and the Lader-Kol gets hold of them, they'll be kept alive for several lifetimes—and none of it will be pleasant."

"There's not much 'if' about them failing. We've got them bottled up pretty well—that passage is the only exit from the officers' quarters. All we've got to do is dig them out," Karn finished grimly.

"I wouldn't be too sure of that," said Van Dorne. "You'll probably find we're stalled well off the patrol beats, and I'd be somewhat surprised if the Lader-Kol didn't have a ship or two hanging around close. They're probably waiting for a signal from Parr now. If they come, we're in no condition to get away." As he finished, Gilda unobtrusively borrowed the case knife he was still holding in his hand.

"We don't need to," Karn stated. "No ship that flies is in any condition to get close to this craft."

"Fifty years ago," Van Dorne pointed out, "the Lader-Kol was equipped with ships that could go through any modern commercial-type screen."

"Well, the screens on this ship aren't quite the ordinary commercial type,"

Karn said quietly.

"Something new?" Van Dorne asked.

"Yeah, something very new," Karn said thoughtfully. Until this moment he hadn't realized the full tremendous implications of his invention. All at once it suddenly dawned on him that he had created the biggest thing in space travel since the introduction of the atomic blast. Up to now, the situation had been no joke, but it had been almost personal. At least, it was confined to this one ship. But in the light of Van Dorne's information about the Lader-Kol, the implications of this mutiny seemed to spread suddenly beyond this ship until they touched the entire System. If this Lader-Kol outfit took the ship and solved the secret of those screens, they would have an advantage over battle craft with present equipment that would make them nearly invincible.

There was a dead, flat seriousness in Karn's voice when he spoke that brought Van Dorne's closest attention and made Gilda look up quickly from her tinkering with the projector. "If the Lader-Kol take this ship," he said, "their idea of ruling the Solar System won't be goofy at all."

"As bad as that?" Van Dorne asked. He knew from bitter experience the importance of shielding screens in spacial warfare.

Karn nodded.

"Well, I guess we'd better go and do some butchering," said Van Dorne.

Gilda returned his knife and handed Parr's flame projector to Karn.

"This will open doors," she said quickly. "It's all right on short range."

Karn was too surprised to say anything, and by the time he got organized they were somehow outside in the passage.

"Be careful, dad," Gilda said to Van Dorne. The words were spoken lightly enough, but Karn heard the deep anxiety behind them. Then they were back with the men waiting outside the corridor to

the officers' quarters.

"I sent a detail down to the workshop and the generator room; sir," Harwood reported. "They're both welded shut."

"That's good," said Karn. "I guess we've got them all in here." A soft chiming sounded from the passage leading to the steward's quarters.

"That's the signal to change shift," Harwood explained unnecessarily. There was the sound of a door closing and a moment later Barnes, the second steward, came down the passage. He stopped at the sight of the entire off-duty crew carrying clubs and crowding in the passageway.

"What's the matter?" he asked in anxious bewilderment, then he caught sight of Karn armed with two projectors. "Is something wrong, sir?"

Karn explained briefly; a deaf person could have followed the explanation quite easily by the changing expression of Barnes' face. "You'll keep your crew on duty until this is cleaned up," he finished.

"Yes, sir," said Barnes from force of habit. "Is there anything else, sir?" And with the words, he was behind his steward's mask of polite attentiveness again.

"That's fine," said Karn with a half smile. "Just keep that up and don't let the passengers know anything is wrong."

"Very good, sir," said Barnes, and with a last look of puzzled wonderment returned to his duties.

KARN TURNED to the men who crowded the passage crossing. "Do any of you remember anything of the Lader-Kol?" he asked.

"Didn't the planetary council have a lot of them gassed for cutting people up a long time ago?" one of the stewards ventured.

"I've read quite a lot about them," Harwood contributed. "But they were supposed to have been wiped out."

"Well, they weren't," said Karn. "They're back of this mutiny. They planned to seize this ship and use the passengers and you to experiment on. It won't be a matter of laying these fellows out and throwing them into the brig; they're too scared of their own outfit to surrender. We'll have to kill them all."

There wasn't a sound from the men as they digested Karn's information.

"That being the case, I'll call for volunteers."

"Count me in," said Harwood. "My wife's on board."

"Who can handle a projector?" Karn asked.

"I can, of course," Van Dorne answered.

"I'll need you to handle things out here," said Karn quickly. "That's an order," he added as Van Dorne started to protest.

"I put in three years on the patrol," one of the stewards stated. "Besides, you've already detailed us."

Karn handed him Parr's projector. "It works on short range," he said. "Use it to open doors. Come on." The five of them went down the passage to the first door.

"Open up, in there," Karn shouted. There was no answer. Harwood swung his bludgeon against the door with tremendous force; the door dented inward but didn't open. Karn nodded to the steward, who stepped forward, switched on his projector, and cut a neat semi-circle around the lock. Harwood heaved against the door with his shoulder.

"They've got something jammed against it," he said and stepped back.

"Cut the hinges out," Karn directed. The projector went into action for a few seconds and it was done. Harwood hurled himself against the door. It twisted sideways and the burly chief steward lunged forward on one knee. His fall saved him from a heavy pair of pliers that flew over his head. One of

the stewards behind him went down with a mouth full of blood and teeth. Harwood leaped in and the thrower died with the jagged end of a piece of pipe through his throat. Then Karn was in the cabin and the other mutineer fell to the floor in charred fragments.

That was the end of round one, and it was short and sweet compared to what followed. For the next forty-five minutes, Karn and Harwood lived and labored through a nightmarishly horrible section of life that they would never forget. From cabin to cabin they fought; the man on Parr's projector was replaced at regular intervals as Van Dorne removed the casualties and sent the rest of the crew in in accurately timed, perfectly disciplined relays. Karn and Harwood stayed; Karn because he would delegate the responsibility of execution to no one else. Harwood because he was the best man for the job. There was only room for one man in the doorways, and Harwood was the biggest and strongest human unit on board. Furthermore, he was tremendously agile for so big a man. This, and a fool's share of luck, saved him from any serious damage as he charged with reckless power into cabin after cabin occupied by two or more berserk mutineers.

IT DID NOT TAKE them long to work out a routine. The man with the short-range projector cut out the locks and hinges, Harwood smashed down the door, and Karn spread searing death with the lashing sputter of the atom flame. The mutineers fought and died with uniformly ferocious madness. The age-long, action-filled minutes stepped by in steady, inexorable procession and the casualty list mounted just as steadily.

Soon the corridors were dimmed with a swirling pungent reek of burned flesh and scorched metal that taxed the power of the air-conditioning apparatus to the utmost. The walls reëchoed the crash-

ing din of Harwood's thunderous blows, the rattle and crack of the lighter weapons of the mutineers, and a perfect bedlam of shrieks, groans, curses and screams of agony, cut short with a muffled thud or the spluttering of the projector.

The noise and smell of battle rolled out along the passage and stopped at soundproof walls and doors. The passengers continued the life of passengers on board a mainliner, entirely unaware that anything other than the normal routine and flight of the ship was going on. Gradually, the action worked to a climax; six of the mutineers were cornered in the last cabin. They didn't wait to be dug out as the others had. They slammed the door open and rushed in a body. Harwood was overwhelmed by weight of numbers and clubbed into unconsciousness. The mutineers charged desperately down the passage, but they hadn't a chance. Harwood's fall cleared Karn's line of fire. The full-throttled, spluttering lash of the projector flame was the theme for a final ghastly carnival of slaughter. Then abruptly the passage was clear and it was done. Karn couldn't believe that it was over; it seemed that they had been fighting this battle for all eternity. He peered down the passage, one hand on the projector throttle, half expecting another mad-dened rush from mutineers that he knew had ceased to exist. There was nothing; just the thinning swirl of choking smoke that flowed slowly past him, and silence, a strangely throbbing, aching silence that was thick and clinging and smothered movement.

Harwood! He was somewhere along the passage. He had fallen down. The thoughts came slowly. Someone should pick him up. Karn thought he was moving to do the job, but his feet didn't leave the floor; he just stood and swayed. He would have fallen, but there was an arm around his shoulders and he was half carried along the pas-

sage to the main corridor; from there he was entirely carried into the control cabin.

The cabin looked like the interior of a field dressing station with casualties sitting and lying about, mostly with bandaged heads and arms in slings. Gilda was running things with a high hand, considerable efficiency, and the unanimous approval of the casualty list.

She leaped up from her job of putting together a badly lacerated scalp as Van Dorne and one of the maintenance men lugged Karn into the room.

"Don't get excited," Van Dorne grunted as he eased their burden onto the floor. "He's all right. He just needs a sniff of the wake-up bottle."

Gilda blushed, a slow crimson tide, right up to the roots of her hair, at the interpretation her father put on her involuntary action. Her hands were full of dressings, but Van Dorne ran a grave risk of bodily damage as he bent over Karn with his back toward her. She fought down her unfilial impulse to plant a solid kick on the parental posterior and turned back to her repair work.

Van Dorne was right. Karn snapped back to consciousness at the first whiff from the wake-up bottle. He sat up.

"Where's Harwood?" he demanded, continuing his last conscious thought. Before Van Dorne had a chance to explain, four of the men carried Harwood in. He was badly bruised and cut about the head and was still unconscious. Karn was almost fully recovered. At the sight of Harwood's limp form he forced the nauseating recollections of the battle from his mind and got busy in his capacity of emergency medical officer. At Karn's direction, Van Dorne broke an anæsthetic capsule under Harwood's nose. For a minute and a half Karn operated as a high-speed barber and removed Harwood's luxuriant crop of dark hair. There were three long cuts that, combined, had nearly scalped the chief steward. They required imme-

diate attention, but these and an impressive assortment of bruises, contusions and abrasions only occupied Karn's hands.

He sent a squad, equipped with Parr's projector, to release the crew imprisoned behind the welded doors of the workshop and the generator room. Another detail was set to work cleaning up the officers' quarters and preparing a casualty list. Karn finished his work on Harwood, and the chief steward's head was looking like the result of a quilting party when Andrews, the foreman of the workshop crew, showed up. He and his companions, busy on some repair work, had not discovered they were locked in until just a few minutes ago. They had very nearly cut their way out with their atomic cutting torches when the squad showed up with the projector.

ANDREWS still didn't know what the battle had been about, but he wasn't asking questions; he was waiting for orders. And he got them; he just about had time to enter the cabin and turn around before he was on his way out to prepare three space-suits for immediate use. The steward reported with the casualty list. The first and second mate and the second radio operator had been killed in their quarters by the mutineers. Karn added to that Parr and the second maintenance officer killed in the attack on the control cabin, the chief of maintenance killed in the failure of the service port, the communications officer murdered, and the casualty list began to sound like an officers' roll call. Karn rubbed his chin and considered the information.

"In an emergency, a commander is authorized to commandeer the services of any of the passengers," or words to that effect." He quoted from his memory of the operating code. "Consider yourself commandeered." He addressed Van Dorne.

"Nothing doing," Van Dorne ob-

jected. "You can't conscript volunteers. If you need a first-class radio operator, I've got a fine, well-fed daughter standing around doing practically nothing," he added.

"Well, yes, we need an operator," Karn said hesitantly. He turned to Gilda, who had just finished putting the first-aid equipment back in the medicine cabinet. "Can you—" he started and realized that was bad. "That is to say, will you—" He stopped again. It was beginning to sound like a proposal. Gilda watched him steadily and let him struggle. Karn felt his face getting red.

"The commander is authorized to commandeer—" Van Dorne hinted suggestively, and that didn't help any. Then Gilda decided to take things into her own hands.

"I'm an A-class operator," she told Karn quietly. "What do you want me to do?"

Karn opened his mouth, then realized that there wasn't anything further to say on the subject. Class A operators were about as common as wooden meteorites. He turned to the passage. "Hanson," he yelled.

A slim, dark man wearing the communication-service uniform stepped into the cabin with a question on his face.

"Miss van Dorne," Karn said formally, "this is Mr. Hanson, third communications officer. Hanson, show Miss van Dorne to the radio room. She'll be in charge there from now on."

Hanson looked bewildered for a moment, then he recovered himself and smiled delightedly all over his face.

"Yes, sir. Certainly, sir," he said enthusiastically. "Right this way, Miss van Dorne," he addressed Gilda, and they went out along the passage.

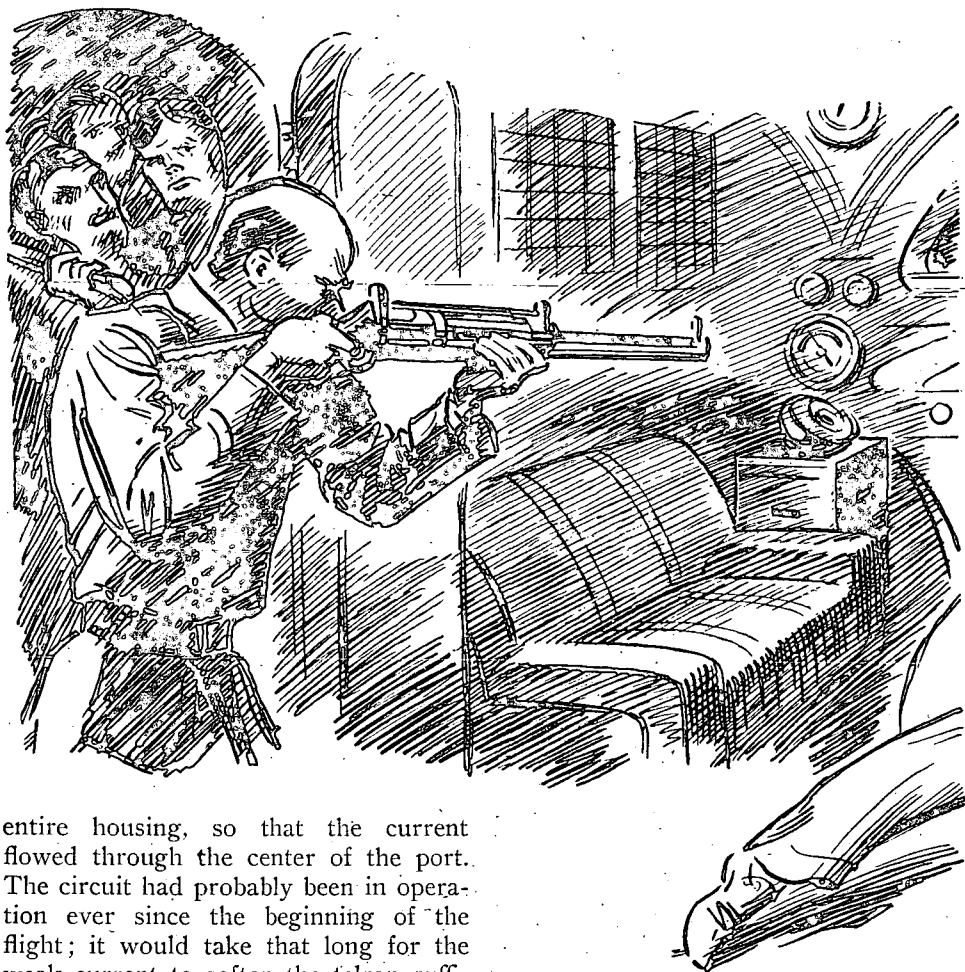
Van Dorne looked up innocently. "Did you say something?" he asked.

"No," Karn growled. "Come on and we'll take a look at that service port." They went out, picked up Andrews and

two of the workshop crew with the space-suits, and went along the right-hand corridor to Station 4. The emergency doors had automatically sealed the passage air-tight when the port blew out. The air in No. 4 station had leaked out through the damaged port and through the exhaust tubes into outer space. It was now an airless void completely cut off from the rest of the ship. Van Dorne, Andrews and Karn climbed into the space-suits.

"You'd better install an air lock here," Karn directed the other two men before he closed his helmet. "We don't need to lose all our air."

THE THREE of them heaved open a small sallyport in the emergency door and were unceremoniously dumped through into the airless No. 4 station on a rushing flood of escaping air, then the sallyport slammed shut behind them. They picked themselves up and looked around at the damage. The decapitated body of the maintenance chief still lay on the floor, but they couldn't bother with him now. They turned their attention to the damaged port. It was built in the form of a tapered plug with the big end toward the inside of the blast tube, and fitted on a quarter-turn compound thread. The small outside end was about eighteen inches across, and almost exactly in the center was burned a perfectly round two-inch hole. Karn stepped to the port and examined it closely. In a moment he saw what had caused its seemingly inexplicable failure. Telron is a peculiar alloy, the formula of its composition a closely guarded military secret. While it resists even the terrific heat of an atomic blast, it is easily softened and rendered workable in an electric resistance furnace. The saboteurs who had planned the disabling of the 457 had taken advantage of this property of the metal. They had diverted the circuit of one of the network of alarm-system wires that sheathed the



entire housing, so that the current flowed through the center of the port. The circuit had probably been in operation ever since the beginning of the flight; it would take that long for the weak current to soften the telron sufficiently. The timing was a simple matter. The current flow had been constant; it wouldn't require much calculation to figure out how long it would take a known current to soften that amount of telron. Karn stepped back from the port and looked at it thoughtfully.

"I guess we'll have to plug that hole," Van Dorne said through his helmet radio.

"We'll need to have the port in the workshop," Andrews added.

"It'll have to go out through the exhaust tube and in through one of the rear lifeboat locks," Karn stated.

"Calling Commander Karn, calling

Commander Karn." That was Gilda's voice. She certainly hadn't lost any time repairing their transmitter. It had appeared beyond hope from the little Karn had seen of it.

"Commander Karn answering," he said automatically. "Go ahead."

"Three ships approaching; calling on micro-wave channel of Patrol Squadron 4A. They are trying to contact us, using no known military or commercial code."

"Hah!" Van Dorne exploded. "Squadron 4A is being refitted at Earth Base. That bunch are Parr's playmates, and they're sending in the Lader-Kol code."



Karn digested that information. "What are you sending with?" he asked with some curiosity.

"One of the lifeboat outfits. Have you any orders?"

Karn felt like kicking himself. He should have thought of the lifeboat transmitters. "Try and get a signal-through to the patrol," he said. "Just ignore those other ships."

"Very good, sir," came the conventional response in a perfect imitation of the monotonous, impersonal voice affected by most operators, and the transmitter switched off.

Karn felt himself cooling off again. That darn female got him going even

He felt her working at his shoe, and talked swiftly, urgently to the man behind the gun.

AST-5

when he couldn't see her. He snapped himself out of it.

"Come on, let's get this port out." In a few seconds the three of them forgot everything else in their absorption in the job. These service ports were opened by a manually operated gear train, but the main gear wheel of No. 4 had the middle blown out, and the heat of the atom flame had warped it so badly that it had jammed the whole train. It required ten minutes of vigorous battering and heaving to remove the remainder of the gear. Persuading the tightly fitting port to describe the quarter turn necessary for its release involved another twenty minutes of laborious levering and considerable sweating, but finally it turned, and they lowered it gently down inside the blast tube. The three of them climbed in after it, to consider the situation from that angle.

IV.

"I GUESS we'd better string a line from here through the exhaust tube and into the lifeboat lock. That way we won't need to be climbing around outside the ship so much," Karn suggested.

"We'll have to have our shielding screens shut off while that goes on," Van Dorne contributed.

"It won't take more than a minute or two to get that port out of the exhaust tube and into the air lock. We'll just have to watch those Lader-Kol ships and pick our time," Karn said, and moved toward the open port. All three of them climbed back into No. 4 station. They stepped over to the sallyport in the emergency door and heaved against it. It opened a little, and air hissed out. The pressure dropped quickly and the port swung easily inward. Ahead of them, the passage was entirely filled with the rotund bulk of the portable air lock. It was in the form of a large rubber balloon, solidly inflated at high pressure to fill the passage. It was equipped

with double doors on either side and a built-in air pump connected to the ship's power plant. They passed through into the passage on the other side. Andrews sent one of the machine-shop men to get a line and went himself to open one of the rear lifeboat locks. Karn and Van Dorne took off their helmets and headed for the control cabin.

They caught up with Hanson in the main passage. He and three other men were going toward the radio room, loaded down with a carload of radio equipment rifled from the lifeboats.

Hanson was bringing up the rear. Karn spoke to him.

"Where's all this going?" he asked.

Hanson was no longer quite so trim; he was sweating, his hair was mussed and he looked a trifle wild-eyed. He was laboring along like an overloaded freighter pulling away from Jupiter, and didn't hear Van Dorne and Karn behind him. He jumped when Karn spoke and looked around. He appeared somewhat relieved when he saw who it was. "I'm taking this stuff to the radio room, sir," he said, and seemed to be glad of an opportunity to stop and rest awhile.

"What's it all for?" Karn asked, somewhat mystified.

"It's that woman," Hanson said darkly. "We started sending with four of the lifeboat transmitters, then those Lader-Kol ships started jamming. They got us completely blanketed and that blonde went primitive on us. She's in there now building an old heterodyne transmitter as big as a moon. It looks like something out of a museum. It's so old-fashioned it only operates on one wave length."

"Well, what about it?"

Hanson looked at Karn as though he couldn't believe his ears. "Aren't you going to do something?" he asked incredulously. "She's had us running up and down this corridor so fast we've got a groove worn ankle-deep. After all, I'm a radio technician," Hanson

finished, accenting the last word.

Karn permitted himself a small portion of a restrained grin. "Miss van Dorne is in complete charge till further notice," he informed the third communications officer formally. "Go on, get back there and learn something about radio," he finished with the rest of the grin.

Hanson looked at him with tragic reproach. "Yes, sir," he said in the voice of a martyr, turned and went toward the radio room, his shoulders drooping. Karn and Van Dorne went on to the control cabin. Somehow, Karn felt an awful lot better.

MOST OF the wounded had been removed to the crew's quarters. Harwood and several of the less badly damaged casualties were standing at the direct-vision ports and watching the proximity gauges for the approach of the Lader-Kol ships.

One of the gauges emitted an irregular series of low, slowly rising notes as Karn and Van Dorne entered; the liquid indicator was bobbing around uncertainly in the bottom of the visible column.

"I think I see them," Harwood announced from his station at one of the ports. Karn and Van Dorne stepped over to his side.

"Where?" Karn asked.

"That bright star and the little one below it," Harwood directed, pointing. "Now right down that line about halfway to the edge of the port."

Karn followed the line Harwood indicated, down across the purple-black backdrop of space until he sighted three tiny half-moons that moved almost imperceptibly across the port. The ships were quartering up from the direction of Earth; the half-moons were the small sections of their sunlit sides visible from the 457. They were approaching at terrific speed, although it was impossible to perceive distance against the jewel-

dusted curtain of space. At one moment the ships seemed to be tiny lights, infinitely remote, and at the next they appeared as steadily increasing crescents immediately outside the port. The crescents were growing rapidly, and soon it could be seen that they were accompanied by the hazy, glowing mist of light from exhaust flames.

"They'll be on our screen in a minute or two," said Van Dorne.

"We'll let them bounce off a couple of times," said Karn. "Then we can cut our screen and get that port around the lifeboat lock while they are figuring it out."

"I hope they do bounce," Van Dorne said uncertainly. He still didn't believe that any commercial-type screen could stand up to direct attack.

"They will," Karn assured him, and they continued to watch the approaching ships in silence. The ships were coming up fast now. They could begin to see the details of the brightly sunlit parts. The outlines of the rest were dimly silhouetted against the glow of the exhaust. Karn slid a screen across the port. That sunlight, directly reflected without any interference from atmosphere, was a little too bright for comfort. The ships had been spread out in a wide echelon formation. They were closing up now and coming in toward the center of the 457.

"They're heading for our midships air lock," Karn observed.

"And they look like they're going to get there," Van Dorne muttered, his eyes on the racing ships. They must have been good pilots to approach at that speed, angling in toward midships. Suddenly things happened with startling, terrific violence. The nose of the leading ship seemed to run into something solid. Its tail came over in a perfect somersault. There was a brilliant flash of mirrored sunlight from the length of the ship as it went over, then its exhaust flame caught up with it and obscured

the rest of the action. The other two ships cut their blasts and managed to roll out and avoid a collision, but they came perilously close to the leader.

Karn grabbed a tiny phone and dialed No. 3 stern lifeboat lock. Van Dorne stayed by the port watching the Lader-Kol ships sort themselves out, but he didn't really see them. He was beginning to realize the terrific potentialities of the screening system of this ship and what it would mean if the Lader-Kol got hold of the secret of its operation. Not even the most powerful screens on military craft stopped a ship as violently as that. Karn got his connection.

"Hello, Andrews, are you ready?"

"Yes, sir," came Andrews' voice. "We got a line on the port plug and moved it down to the exhaust tube. We rigged a phone line into the blast tube from No. 5 station," he added.

"That's good," Karn commented. "You stand by your phone. I'll cut in No. 5 station and make this three way." Karn dialed in the other phone. "Harwood," he called. "The rest of you men can return to your quarters," he ordered the others.

KARN CLOSED the door on them and turned to the projector cabinet. It was still open. He reached in and slid the back panel aside, disclosing a massive switch handle.

"That cuts our screens," he said to Harwood. "Put an extension on that phone and keep your eye on those ships. When we are ready at the stern I'll give you the word, and if they don't look like they are going to try closing in, cut the screens. If they make a move to approach, let us know. We'll duck for cover if we're outside and then you switch on again. Got that?"

Harwood repeated the essence of what Karn had said. "O. K. Come on, let's go," he said to Van Dorne.

They stepped out of the control cabin and ran down the corridor to No. 4

station. In a moment they had their helmets clamped on and stepped into the air lock. They went through fast, and some air followed them out. Karn opened the sallyport and stepped into airless No. 4 station. Van Dorne followed him, and they crawled through the service-port into the blast tube. The port plug had been moved down to the exhaust-tube outlet. As they walked down to it, one of the workshop crew was standing by with the phone extension connected through his helmet radio.

"Are you in touch with the control cabin?" Karn asked him. The man said he was. Karn called Harwood and got an answer.

"They're still standing off," Harwood told him. "Shall I cut the screens?"

"Not yet—I'll tell you when in just a moment." Karn and Van Dorne climbed over the port plug. Karn picked up the coil of line attached to the plug. "All right, cut them," he said. In the control cabin Harwood pulled the switch and stepped back to his observation post.

Karn handed the coil of line to Van Dorne, then reached up and grabbed the lip of the exhaust tube above his head. He pulled himself up and struggled outside. He reached back and Van Dorne handed him the coil. As Karn turned around, he saw No. 3 lifeboat lock open and Andrews waiting. He threw the line toward the lock; it snaked out, arched away from the ship and started falling back. Andrews caught it as soon as it came in reach and quickly drew in the slack. The two men below heaved the plug up to Karn, and, with Andrews pulling on the line, he worked it past the lip of the exhaust tube and outside. From there it was easy. Karn pushed, Andrews pulled, and the plug was nearly to the lifeboat lock when Harwood's voice cut in on the proceedings.

"The ships are moving, they're circling out," he informed them. "They are coming about. I think they're going

to come in. Yeah, here they come!" Harwood finished almost shouting.

"Switch on!" Karn yelled in reply and dived for the exhaust tube, but Harwood must have moved even faster. Karn's feet were still outside when the shielding screens went into action. He was yanked unceremoniously feet first out through the exhaust tube. Van Dorne saw him going, grabbed his wrist and started sliding out after him. The telephone operator leaped for Van Dorne and threw a bight of the telephone cable over his shoulders. The cable held and so did Van Dorne. For two aching seconds he held while Karn stood out stiffly away from the ship, vibrating tensely in the grip of the repulsor field. Then the approaching Lader-Kol ships cut through the outer reaction screen. The instantaneous control immediately concentrated the repulsor field in front of them. Van Dorne catapulted back up the blast tube with Karn on top of him.

He rolled onto his feet. Karn got up a little shakily, his feet still a bit numb and disinclined to support him. He reeled all over the curved floor of the blast tube before Van Dorne got hold of his arm and steadied him down.

HARWOOD'S huge hand nearly pulverized the tiny phone he was holding as he watched the approach of the attacking ships. He wanted desperately to run somewhere, but there was a terrible paralyzing fascination in the slow, sweeping curve of the three ships as they came about and then arrowed straight for the middle of the 457. They were executing with precision and efficiency the maneuver usually employed to break through repulsor screens. They were approaching at full throttle, their courses laid to converge on as small an area of the screen as possible. Ordinary commercial screens would inevitably have failed before such an accurately concentrated attack, but it was exactly the type of maneuver that the instantaneous-re-

action control was designed to resist most effectively. The ships had swung around and the Sun was on their stern quarter. All that could be seen of them was the faintly glowing, lengthening exhaust trails streaked across the eternal night—three perfectly straight luminescent lines widening and reaching rapidly to their point of convergence in absolute silence. The lines drew in with geometric accuracy to that point and stopped, then spread and blurred in a nebulous cloud that flowed away from the point and spread slowly around the 457's repulsor screen. Aboard the mighty liner there was no hint of the tremendous fury of power that had been expended in the blasting exhaust flames of the attacking ships—power that had been met, balanced and nullified, canceled out with mathematical exactness, by the delicately precise control that Karn had created. There was no crashing impact; just the silent, flashing production of three lines to their convergence, then the slow spread of the exhaust cloud.

The change of tempo had been so abrupt and complete that Harwood felt nearly as stunned and bewildered as the crews of the Lader-Kol ships actually were. They had been strapped in their deceleration harnesses, but these shock absorbers were designed to deal with deceleration, not with an absolute, instantaneous cessation of motion. Most of them now hung limply in the webbing, completely unconscious. Several were bleeding at the nose and mouth, the vivid green of their blood lending them a ghastly, unhuman appearance. The ships were dead-still, drifting with the 457. There had been no remainder in the exact cancelling out of that equation of power to give them motion. For long moments nothing moved other than the slowly dispersing exhaust cloud. Then someone on board one of the flank ships evidently recovered. The blast came to life with a gentle mushrooming

of exhaust from a drive throttled down to dead slow. Cautiously the ship rolled out and circled away from that spot where such violent things happened so suddenly. Soon the other two ships circled out and joined the first one. They pulled into a triangle formation, nose to tail, set up a slow axial rotation to maintain position, and went into conference to decide what had happened and determine what they should do about it.

Karn and Van Dorne saw nothing of this brief but decisive action. By the time the Lader-Kol ships were standing off again, they were just emerging from the air lock outside No. 4 station. They were heading for the workshop, which was directly opposite them but on the other side of the blast tube. It was necessary for them to go back to the main passageway and down the corridor on the left side of the drive. In the main passage they met Barnes, the second steward. He was looking worried.

"Anything wrong?" Karn asked when he saw him.

"Some bright young squirt has been spending all his spare time checking our course. He's just informed everyone that we aren't driving," Barnes told him. "Then several other passengers saw those patrol ships come up. They're mostly standing around now trying to put two and two together and make it come out right. They'll be questioning the stewards in a moment."

"Hm-ni-m, that's bad," Karn commented. They had enough trouble on their hands without the passengers getting excited.

"In the early days," Van Dorne announced, "some of the commercial ships used to take a chance and run without screens to save power. There were some bad accidents, and the patrol got the job of sneaking up on any ships they came across to see if the screens were working. Maybe the commander of that patrol squadron is just reliving the

good old days," he said, looking Karn straight between the eyes.

KARN GRINNED. "And that's good," he said. "We could touch it up a little, maybe. Let's see." He rubbed his chin and looked thoughtful. That evidently wasn't enough. He frowned and partly closed one eye. Barnes and Van Dorne began to assume pained expressions in sympathy. "I've got it!" Karn announced and they all relaxed.

"O. K., let's have it," Van Dorne suggested.

"It's like this," Karl explained. "This is a new ship on its maiden voyage. Probably none of these passengers have been on a first trip before. This business of patrol ships tearing up and bouncing into our screens is the usual procedure with new ships—we've been hanging around here waiting for them. They always do that to make sure everything is working all right."

"Sure they do, certainly they do," Van Dorne seconded emphatically. "They always do; I've seen them do it," he added, deciding that he might as well be a good liar while he was at it.

Barnes was beginning to look happy again.

"Well, anyway, that's your line," Karn told him. "Feed it to them till they choke."

"Yes, sir. I will, sir," said Barnes and went back to his duties prepared to dominate the situation.

"I hope that holds them," Karn said seriously, after Barnes had left.

"It will," Van Dorne assured him. "Come on—we've got an appointment with a blown plug."

They went down the passage to the workshop doorway. The door had been cut off at the hinges, and was leaning against the wall. They walked inside. The port plug stood on end under the drill press. Andrews, several of the workshop crew and Vernier, the generator technician, were standing around

considering the situation.

Andrews, still in his space-suit, looked up when Karn entered.

"We'll have to ream that hole out on a taper and make a tapered plug to fit it," he said.

"You'll have to soften the telron before you ream it with anything," Van Dorne pointed out.

"How long will it take our lighting circuit to soften it up?" Karn asked.

"Six hours—or somewhere around that," Andrews answered.

"We could use the shield generators," Vernier contributed. "They'd reduce that plug to a puddle in about ten seconds."

"We could do that," Karn agreed slowly. "Yeah, that's what we'll do," he decided. He picked up the phone and dialed the control cabin.

"Hello, Harwood. What are they doing now?" he asked.

Harwood gave a short laugh that was mostly a snort. "Nothing—just nothing at all. Boy, the way they ran into that screen, I bet they're still trying to get their feet down from behind their ears."

"Then they don't look as if they are going to do anything immediately?"

"They don't look as if they are ever going to do anything," Harwood replied.

"Well, keep that switch closed," Karn instructed. "We're going to shut the generators off here. You stay there and let us know if they make a move," he finished, and left the phone.

"We gotta work fast," Karn announced and went on to explain just what they would work at. Four of the workshop crew were sent to remove an atomic drive from one of the lifeboats. Its telron would be used to fill the hole in the port plug. They went about their job with sadistic enthusiasm. Most of their lives had been occupied with the careful maintenance of Interplanetary's equipment. They now had definite orders to tear the motor out of one of the

lifeboats as quickly as possible without regard to what happened to the rest of the boat. They looked forward joyously to half an hour or so of unrestrained destruction. They got a couple of cutting torches, assembled a kit of tools, and departed in the direction of one of the stern lifeboat locks with all the murderous enthusiasm of a war party of Venusian Hillmen descending on an undefended settlement of Valley Dwellers.

V.

"WE'LL RUN the field-generator output through the drill press. We can install a double-throw switch so we can shove the power back into the repulsor field if those Lader-Kol people try to come in again." Karn stopped; Andrews was giving him a funny look. "What's the matter?" Karn asked.

"We haven't got a switch available that'll take the generator load," Andrews said.

"We can build one," Van Dorne stated.

"How long will that take?"

"Half an hour—no more."

"O. K., get going. Andrews, you're taking your orders from Van Dorne."

"Very good, sir," Andrews replied readily enough.

"I'll help you wire the drill press," Karn told Vernier.

For the next half-hour the after part of the 457 looked more like the interior of a machine shop than any part of a luxury liner. At the end of that time the work began to show results. The wrecking crew reported with a very nearly complete set of barked knuckles and one complete atomic drive. A shattered ruin that had once been a lifeboat marked the place where they had been working. Van Dorne, working almost entirely by rule of thumb and relying on his memory for load factors of various conducting and insulating materials, had succeeded with Andrews'

help in evolving a two-hundred-pound mass of bar copper and insulating material which he insisted was a double-throw switch and would operate as such.

Karn and Vernier returned from the generator room where they had finished the final details of the wiring.

"How's the switch coming?" Karn asked.

"It's come," Van Dorne announced and stood aside to give them a clear view of his masterpiece.

"Holy gosh!" Karn exclaimed involuntarily. "There's sure lots of it," he added.

Vernier nodded. He was a little gray, weathered man and didn't say much. "It's good," he said with satisfaction. "It'll take the load. Let's get it in the generator room and connect up."

Vernier's word was enough—he was an acknowledged authority on electrical equipment. Four of the men made light work of moving the switch to the generator room. Karn and Vernier connected up. They finished the job and stepped back.

"We're all ready for business," Karn announced, and they trooped back to the workshop. The port plug was wrestled onto the bed of the drill press and spotted in position.

Karn picked up the phone. "Hello, Harwood. Everything quiet?"

"Yes, sir. They haven't made a move."

"Good. Keep your eye on them—we're going to switch off now."

Van Dorne returned to the generator room to preside at the switch; Vernier went with him to see that no harm came to his generators.

Karn cut the phone to the generator room into the circuit. Van Dorne answered.

"You can throw it over whenever you're ready," Karn told him.

The result was an immediate leap of an arc flame between the reamer and the telron plug. Andrews ran the

reamer down into contact, and the plug immediately began to heat up. In a few seconds it was glowing blue-white all through.

"Hold it at that," Karn called to the generator room. Andrews started the reamer, and a long spiral of softened, glowing telron began to climb out from under the head. The reamer bit in deeper and deeper and the cuttings began to pile up on the bed of the press. Suddenly the phone buzzed in Karn's hand; he lifted it to his ear and held it there a moment. With the buzz of the phone they had all stopped what they were doing and looked at Karn.

"Back that reamer out!" he ordered tensely. "Generator room, switch to screens."

IMMEDIATELY the glow began to fade out of the mass of telron, as it started to harden and contract. Andrews had moved fast on the drill-press controls and got the reamer clear.

"What's happening, Harwood?" Karn asked.

"They've come in to our screen," Harwood reported. "They're cruising around all over it—looking for a hole, I guess. Two of them have gone out of my sight now."

"Get men at all the direct-vision ports, tell them to cut in on the phone circuit and report what those ships are doing," Karn ordered.

They waited in silence for thirty seconds that seemed to be as many hours.

"Two of the ships are working from midships forward," Harwood reported. "One is heading for the stern."

"Get a line on that one," Karn ordered.

Another voice cut in. "Ship just going by me, headed for the stern. It's out of my sight now."

"No. 3 stern lifeboat lock," came a report. "Patrol ship in sight. It's taking up position directly astern. I think it's trying to come up our exhaust lane."

"Damn!" said Karn. "That's what I was afraid of."

"Something wrong?" Van Dorne asked.

"One of them is trying to come up our exhaust lane. It's not shielded."

"Can they do it?"

"I guess he can if he's got enough power. The repulsor field will only hit his ship around the edges. Hello, stern, how's the patrol ship making out?" he asked the phone.

"It's doing all right up to now. It's moving pretty slow but coming in— Oh-oh." There was a pause.

"What's happened?" Karn snapped.

"I guess he got off course," came the reply. "He turned broadside on and he's right back where he started from."

"Is he coming in again?"

"No, he's circling out. Now he's heading toward midships. There, he's gone out of my sight."

"Hello, Harwood. Can you see anything yet?"

"Yes, sir. They're all in sight and heading away from us. Looks like they're getting back into position where they were. Yeah, that's what they're doing."

"Oh. Well, you keep watching and tell me if they make any more moves. Generator room, let's have the power." Karn put the phone down and rubbed his chin thoughtfully. "That's funny," he said. "They could have come in there with a little trying."

The telron was coming up to color and the reamer started deliberately chewing it out again. The phone buzzed viciously. Gilda's voice came through. "Radio room calling," it said.

Karn had almost forgotten about her. "Commander Karn answering. Go ahead."

"Lader-Kol ships are pooling their transmitter output. I think they are calling for reinforcements."

"How did you manage to break their

code?" Karn asked involuntarily and then wished he hadn't. The ability to break practically any code was one of the first requirements of an A-class operator.

"Oh, I'm just naturally a lucky guesser," Gilda replied with quiet intensity. Karn winced.

"Say, listen," he started, "I didn't—" Then he stopped as he realized that he wasn't speaking to anyone. He put the phone down carefully to make sure he didn't slam it onto the floor. He took a deep breath and let it out slowly.

"They're sending for reinforcements," he told Van Dorne.

"I don't blame them," Van Dorne commented. "Even if they got into the blast tube, it would be some job to get out through that port with one of us feeding them a projector flame."

"I guess so. You can switch back to screens," Karn added as he got a signal from Andrews. "Finished?"

Andrews nodded. He and four of the men got tongs on the still-glowing port plug and slid it onto the floor. Then they heaved the blast tube from the lifeboat onto the bed of the press.

"You want to run the current through that?" Karn asked.

"Yes, sir, if you'll connect it up. We can soften the telron, run this press as a trip hammer, and forge the shape we want."

KARN SHIFTED the heavy connections from the head of the drill press to the mass of telron. He checked the position of the Lader-Kol ships with Harwood, then called the generator room for power. The current came on and steadily increased until the telron glowed approximately the right color. Karn signaled the generator room to maintain that current flow and then they went to work. Karn, Andrews and the drill press functioned as a single unit. They were all expert at their particular job. Andrews at the controls of the drill

press, the press responding perfectly to the controls, and Karn, holding onto the insulated power cables, turned the metal on the anvil. Soon the rough shape began to appear. It lengthened and thinned and smoothed as the work progressed. The hammer shortened and speeded its stroke until its movement was invisible as the job neared completion. Then Karn nodded, the hammer stopped at the top of its stroke, and in a second Andrews had switched to a shearing head and the ends of the plug were neatly cut off.

At a word from Andrews, the port plug was heaved back onto the bed of the press. Karn was at the phone and had the power shut off before it was in place. He disconnected the power leads, switched them back to the port, and called for juice. Karn watched closely, and as soon as the brightening color of the port matched the fading color of the plug he dropped it into the hole it was intended to fill. It projected four inches from the port, but not for long. The trip hammer rapidly slugged it down to a smooth, almost invisible, fit.

Karn found that he was sweating profusely and he was beginning to feel tired. He reached for the phone. "You can switch back to the screen for keeps. We're finished," he told Van Dorne, and put the phone down again.

"I guess the next thing is to get it out to the lifeboat lock," he said to Andrews.

Andrews nodded. "Just as soon as it's cool," he agreed. Van Dorne returned to the workshop, and he and Karn climbed back into their space-suits. They waited awhile, then Andrews touched the port plug experimentally. It was still hot, but they could handle it. The next operation was a progressive struggle against the ship's gravity generators that ended with the port plug back in No. 3 lifeboat lock. Karn was about to open the outer door of the lock when his helmet radio gave vent to a high-pitched scream that whooped wildly

up and down the scale. Finally it fixed on one intensely piercing note. Then it broke up and began to stutter out the emergency call of the interplanetary patrol. The call was tremendously powerful, and inside the helmet it was unbearable. Karn shut off his receiver. That call evidently was the result of Gilda's machinations in the radio room, and judging by its volume and concentrated power it must be getting through. Karn turned to Van Dorne and pantomimed with his hands to his ears. Van Dorne grinned back at him and nodded understanding. Karn felt quite happy as he opened the outer door of the lock. The line was still in place from the lock to the outer end of the exhaust tube, but it bowed outward in a deep arc in the grip of the repulsor field.

Karn switched on his radio. The call was still screaming out at full power, and he shut it off again. He turned and signaled the telephone operator to tell Harwood to cut the screens. The operator shook his head, waved the phone cable and motioned Karn back inside. Karn looked inquiringly. The operator repeated his gestures more emphatically. A sudden flood of light filled the air lock, then it was gone just as suddenly. Karn looked outward. One of the Lader-Kol ships was drifting by; the light had been reflected sunlight. As he watched, the ship came about into position directly astern and started trying to come up their exhaust lane. It came on steadily for awhile at full throttle, making slow progress against the small portion of the repulsor field that impinged on the outer edges of the hull's cross section. Then it veered off course slightly, the repulsor field caught it and whirled it outward before the pilot had a chance to get back on course. The ship swung out in a wide arc and started back in again. Karn stepped back through the air lock into the 457. He opened the front of his helmet and

turned to Van Dorne, who had followed him.

"What the devil made them change their minds?" he asked.

"I guess that call was getting through, and they decided not to wait for their reinforcements," Van Dorne answered. "If we cut our screen to get that port into the blast tube, they're going to come aboard us," he added.

"And if we don't, they're going to come in anyway."

"Maybe we could hold them in the blast tube till the patrol gets here," Van Dorne suggested.

"Not if they poke a few atomic bombs through that open porthole," Karn pointed out.

THEY STEPPED over to one of the direct-vision ports. The ship was coming in again, battling full-throttle against the drag of the repulsor. It got almost halfway to the exit tube of the 457 before it sheered off course and was hurled out into space again. It reminded Karn of something, then suddenly he remembered what it was.

"Did you ever have any training in jujitsu?" he asked Van Dorne.

"In what?"

"Jujitsu."

"Sure, but what's that got—" He stopped. "Am I thinking what you're thinking?" he asked.

"Probably. I figure the next time he comes pushing against our screen at full throttle we'll just relax and let him go by under his own power. Then we can try to get the plug around and into the blast tube before he has time to circle back and come in again."

"Providing, of course, that he doesn't hold course and cave our stern in," Van Dorne supplemented cheerfully.

"I don't think he will. Whatever color his blood is, he's a darn good pilot."

Karn took the phone. "Yeah, I know.

We can see him," he said in reply to Harwood's report that one of the Lader-Kol ships had gone out of his sight. The other two ships were still in position, he added.

"O. K., that's good. Forget them and keep your hand on that screen switch. The operator here will tell you to cut in a minute or two. When he does, you yank that switch as fast as you can." Karn turned away from the phone and arranged his signals with the operator; the emergency call going out kept their helmet radios out of commission. He sent Andrews and four of the men down into the blast tube to pull on the line from that end. The port plug was made fast to the other end, and the outer door of the air lock opened again.

By that time the Lader-Kol ship was in position once more and coming in. Drawing on the experience of his last two failures, the pilot inclined forward with infinite care and consummate skill. Karn marveled at the masterly handling of the ship as it came steadily closer, not deviating a fraction of an inch from its course. Such perfect control could only be attained by members of the Lader-Kol, for it required more training than could be crowded into one normal human life. It was coming closer—it passed the halfway mark—the watchers involuntarily tensed themselves, ready for action. Karn lifted his arm for the signal; the tension became almost unbearable. He dropped his arm; the telephone operator let his breath go in a yell.

The approaching ship leaped forward with the full power of its drive. It hurtled directly toward the stern of the 457; Karn got a fragmentary flashing view of its starboard quarter as it pulled out; there was a momentary grating, jarring shudder to tell them how close it had been.

The screens were shut off and the line began falling slowly back to the ship. Then it snapped straight as An-

ASTOUNDING SCIENCE-FICTION

draws and his men heaved their strength against it. Karn and Van Dorne boosted the port plug out of the air lock and it slid rapidly across the outside of the hull to the lip of the exhaust tube. Karn pulled himself quickly along the line after it and worked it around the edge. The men inside heaved, and Karn went in with the plug. Van Dorne had been watching from the air lock; he signaled and the screens flashed out again.

Quick as they had been, the Lader-Kol ship had lashed around and was halfway through their screens before they went into action. Then the concentrated power of the repulsor field caught it and hurled it end over end back into space. That kind of treatment didn't seem to bother the Lader-Kol pilot at all. He pulled his ship around in the tightest turn Karn had ever seen, and a moment later was working his way back up the exhaust lane with undiminished determination.

VI.

KARN WAS helping Andrews and his crew shift the port plug back to No. 4 station where it belonged. It was hard work, but they were strong men in a hurry and it wasn't many seconds before the plug was in place by the port. Karn looked back. The nose of the Lader-Kol ship was in sight, framed in the exhaust tube. The pilot was beginning to get the hang of things and was coming in faster than before; already he was too close to try letting go the screens again.

Andrews sent one of the men out to open No. 3 port while the rest heaved No. 4 plug into position. They lined it up and it went into place, all but the last two inches. Karn signaled them to pull it out again. They lowered it to floor and rolled it over. Karn and Andrews got down on their knees and examined the thread with careful haste. It was Andrews who found the small

piece of telron reamer cutting jammed in the threads.

He went up the blast tube to No. 3 port by the time it opened and stood back as the extending rod attached to the port reached in and lowered it to the floor. Then he signaled for tools. Karn looked back at the nose of the approaching Lader-Kol ship. It filled the whole field of vision from the exhaust tube and was closing in steadily. It was close enough for Karn to see the pilot clearly, as he sat at his master control panel, moving his hands constantly over the buttons and levers as he sensed and corrected every slightest variation of direction and power of his drive and the resistance of the 457's repulsor screen. He was a full-fledged member of the cult, his face tinged with the pale, unearthly green of his copper-based blood. Karn could see his eyes now, and they were utterly expressionless in the expressionless mask of his face. His body was trained through several lifetimes to respond perfectly to his mind, and his mind was just as completely trained to respond to the will of his leader. If he had been ordered to bring his ship into its present position while the 457 was in flight and its exhaust tube pouring forth a river of flaming destruction, he would have tried it with the same passionless skill and precision that was now working it steadily closer. Karn, half hypnotized by the slow, steady, seemingly resistless approach, suddenly realized that the ship was coming too close; they would have to hurry or the Lader-Kol men would be aboard them before they could seal the blast tube. He looked around, as Andrews returned with a handful of chisels and a small sledge hammer. In a moment, Karn had selected a chisel and was holding it in place while Andrews swung the sledge. It seemed funny, working in the airlessness of space. There wasn't a sound from the blows of the hammer; Karn could just

feel the jar of its impact. With their helmet radios off, he realized for the first time the utter isolation of anyone outside the wisp of atmosphere that clung precariously to the tiny pebbles of planets, so tremendously important to life, so utterly insignificant in the immensity of space. As they labored desperately to protect themselves from death or worse at the hands of members of their own race, Karn marveled at the presumptuous effrontery of that race. By merely inhabiting a few minor planets and hurling tiny ships across comparatively short distances of space they assumed that they controlled the universe, then fought among themselves to decide who should exercise that control.

Karn's life and the lives of everyone else on board this ship depended now on one tiny fragment of metal that had inadvertently got into the wrong place. It showed every indication of staying there; the hard alloys of the chisels scarcely made an impression on the stubborn toughness of that scrap of telron. Karn tried another chisel, and as he reached for it he got a glimpse of Andrews' face. It was pale and sweat-streaked, tense with the strain of accurately controlling the blows of the hammer; if he missed or struck too hard he might easily damage the threads beyond immediate repair.

KARN HELD the chisel and waited for the jar of impact. It didn't come and he looked up. Andrews pointed wordlessly down the blast tube. Karn looked. The Lader-Kol ship was within twenty feet of their stern. As he watched, the bow port opened and he could see two of the Lader-Kol men ready to come aboard them the moment the distance between the two ships was small enough to leap—and that would be in a few seconds. He turned back to Andrews and motioned him to swing the hammer. Andrews shook his head.

"We can't make it!" his lips formed soundlessly in stark terror. He made no move to obey.

"Gimme that hammer," Karn yelled uselessly, and grabbed it. He yanked Andrews' hand down and practically wrapped it around the chisel. He swung the sledge with all his strength. The swing followed right through and he dropped the hammer. Then he bent and looked closely at the obstructed thread. The scrap of telron was sheared out as neatly as though it had been machined.

The rest of the men didn't wait for an order; they heaved the plug back into position and shoved it solidly home.

He looked back. The Lader-Kol ship had closed in to within ten feet. Suddenly one of the boarding party leaped; he hurtled through space and sprawled on his face on the bottom of the blast tube. Karn lunged toward No. 3 port as the invader struggled quickly to his feet and tried to bring his projector to bear. The commander of 457 got a brief impression of intolerable brightness as the atom flame licked out toward him, then he was into the port and two of the men dragged him through. The port plug followed practically at Karn's heels as two more of the men labored frantically at the manually operated gear train, but even so they got a glimpse of one of the Lader-Kol men as he tried to jam the muzzle of his projector into the rapidly closing port.

The port closed and turned to lock in place. The emergency doors that had automatically closed off No. 3 station when the port had been removed slid open again. Karn struggled out against the tide of inrushing air and almost climbed right over Van Dorne, who had been waiting outside. Without thinking, Karn snapped on his helmet radio to speak to him, but it was no use—the emergency call for the patrol was still screaming out with a volume and intensity that blanketed everything else.

He was limping badly when he got

there, but didn't seem to notice it.

"We've got 'em!" Karn yelled to Harwood, and reached for the ignition-circuit switch. He closed it and yanked the lever of the automatically adjusting throttle to full open. That's all there was to it in the control cabin, but in the blast tube a ravening torrent of flame filled it across and lashed down its length with the speed of light. The two Lader-Kol men who had come aboard did not, in a sense, die. They just ceased to exist with such terrific violence that it seemed to blot out the whole course of their lives. The ship they had left had final, momentary existence as a brilliant burst of intense light, then all that was left was the tell-tale housing of its atomic drive. In a fraction of a second it was just a somewhat dull pin point in the lambent glow of 457's exhaust trail.

In the control cabin, Karn picked up the phone and got in touch with the stern. "What happened to the ship astern?" he asked.

The voice that answered sounded a bit shaky. "It's gone—it's just gone," it repeated somewhat dazedly.

"That's all I want to know," Karn said and hung up.

HIS LEFT FOOT had been hurting a little, and now, as he turned away from the phone and put his weight on it, a sudden burning pain seemed to stab up his whole left leg. He grunted and jumped, lost his balance and fell to the floor. The cabin did a couple of complete turns, tilted sideways, slid rapidly nowhere and then blacked out. Van Dorne just missed catching him. Two of the stewards jumped to Van Dorne's assistance and between them they lifted Karn and stretched him out on one of the locker seats. One of the steward's grabbed a wake-up bottle and fed the commander a snort. He came to in a moment and gritted his teeth against the pain in his leg.

"We'll get you out of this space-suit," said Van Dorne.

"O. K.," Karn replied, "but go easy on my left foot. That Lader-Kol fellow took a shot at me. I think he must have warmed the boot up and burned my foot a little."

"Yes, I guess so," agreed Van Dorne. He looked at the boot. There wasn't any bottom to it at all, and the bottom of Karn's foot looked like a raw steak that had been dropped on a red-hot stove. "Yes, he did singe it a little," he commented and then turned to help the steward who was working the space-suit down toward Karn's feet.

Gilda came in while they were busy; she saw what was wrong and started getting things out of the medicine chest. She was utterly weary and moved almost automatically. Van Dorne and the steward got Karn's space-suit off him, and Gilda took over from there. She spread out the dressings and then looked at the wound. Her heart almost stopped; she knew a projector burn when she saw one, and her mind immediately leaped away up an avenue of possibilities. A little higher and there would have been no foot—a little higher than that and there would be no Commander Karn. The shock of that thought was enough to return her to complete wakefulness. She concentrated on her task, and in a few minutes the wound was dressed with almost professional skill.

"Four of the patrol squadrons reported in, and I gave them our position," she said as she worked.

"That's good," said Karn and tried to think of something else, but he couldn't, and nothing further was said till Gilda had finished.

She stood up. "Is there anything else?" she asked.

Karn didn't say anything for a moment. Pain was rising from his injured foot now, and surging over him in throbbing waves. "No, I guess you'd better

go off duty for eight hours or so," he said finally between throbs.

"Very good, sir," Gilda responded, and left the control cabin wishing she had said practically anything else. For a moment Karn wondered whether she had intended it as sarcasm, then pain swamped over him and blotted out all thought. The pain receded and left him with another thought.

"I'll have to check the course," he said and tried to sit up.

Van Dorne pushed him back. "The dickens you do," he said. "I was checking courses long before you were born. I think I can still dodder around well enough to do another. Here, drink this," he added, and held a cup of water in which he had dissolved a couple of capsules to Karn's lips.

"What is it?"

"Don't worry; just drink it."

Karn drank. The pain in his foot, his anxiety for his ship, and the vague worry about Gilda's aloof attitude slid away from him and left nothing but a complete, restful suspension of thought.

When he returned to consciousness again some eight hours later, his thoughts continued from where they had left off, but there weren't so many of them. The pain from his foot had almost ceased, and as he lay drowsily watching Van Dorne at the controls, all anxiety about the ship vanished. That left him only Gilda to worry about. He

was rapidly getting nowhere with that angle when he glanced at the illuminated course chart. He sat up quickly.

"Why didn't you wake me up sooner?" he demanded. "We must be just about ready to come in to Mars Base."

"We are that," Van Dorne agreed. "There's a crutch there if you want to get up."

"I wonder who the inspector will be," Karn ventured finally. "And what he's going to say about the lifeboats we wrecked."

"I think he'll understand," said Van Dorne, and pulled his hand out of his tunic pocket. Karn glanced at what he held and then looked intently closer.

"Say, are you—" he started.

Van Dorne nodded. "Yeah, I'm the inspector," he said. "Well, what do you think, daughter?" he demanded suddenly in Gilda's direction.

Gilda had been gazing in a preoccupied manner out through the port. She turned quickly at her father's question and met Karn's eyes. They held her and she felt herself beginning to blush, but she didn't look away.

"I guess he'll do," she conceded finally.

"Well, give him this," Van Dorne ordered. He handed her the circlet and started for the door. "I've got to go and get my report written up," he explained unnecessarily. Nobody heard him.

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Black—and a bibulous
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"... and therefore, by the authority vested in me, I confer upon you, honoris causa, the degree of Doctor of Science, and all rights, privileges, and prerogatives pertaining thereto." The president of the university extended the scroll. The politician accepted it, bowed, and smiled. The president bowed and smiled back. Flynn, the politician, stepped to the front of the stage and began his speech on "Science and the People."



RIGIBLE

In the audience, Mrs. Alonso, who had come to see her son graduate, squirmed, for she was fleshy, and June days in New York are apt to be sultry. Then she became aware of something peculiar about one of the wearers of academic caps who occupied the front rows. The normal human ear is pink and hairless, and lies more or less flat against the skull. The ears of the cap-wearer were covered with black fur, and

AST—6

Wherein Johnny Black solves a mystery, meets an animal near as fabulous as himself, and proves that clarity of mind may be aided by matter—lots of matter...

stuck out at an altogether unhuman angle. The ears' owner turned his head slightly, and Mrs. Alonso gasped. The cap was that of a receiver of a degree at Columbia University, but the yellowish muzzle was that of a bear!

JOHNNY BLACK lay prone in the warm Caribbean sun, reading a book propped against the roots of a tree in the courtyard. A fly buzzed around his head; Johnny watched it out of the corner of his eye. The opportune moment came; his jaws snapped, and there was no more fly. He swallowed, and reflected that there were some advantages in being a healthy American black bear—strong muscles, lightning reflexes, and a stomach that could digest anything short of scrap-iron. A man, now, would be nauseated by the mere thought of eating a fly.

Still, he wished he could talk like a man, instead of having to write with one claw on one of these trick pads on which a mark appears when you scrape it, or pick away laboriously with his claws at a typewriter, whenever he had something to say. Take these scientists who came down to the St. Croix Biological Station to give him mental tests—they often inferred that because he couldn't talk he couldn't think either. He knew that, thanks to Methuen's famous cerebral injection, he was as smart as most of them, and it annoyed him to have them talk pidgin-English to him. He also resented the familiarity that some developed. During one test he had been irritated enough to scrawl on his pad, "Do you scratch *all* your test subjects behind the ears?" and shove the pad in the professor's face. Well, there had been fewer of those fellows around lately; there were, it appeared, financial difficulties in the science business.

He pushed his spectacles, which had been displaced by the jerk of his head, back into place, and resumed reading.

But it was interrupted again, this time by a thin, piping song:

*"Ha-ha-ha, shake a leg;
We must finish up this keg,
When the rest have hit the floor,
We will drag in one keg more.
Ha-ha-ha, you and me,
Little-brown jug, how I love thee!"*

Old Sarratt again, thought Johnny. Gordon Sarratt, tottering wreck of what had once been a great geneticist, was allowed to live at the Station and putter with goat-breeding as a sentimental gesture toward his past scientific accomplishments and reputation.

A storklike man with a little gray goatee strolled into the courtyard: Ira Methuen, Johnny's boss and the Station's new director. After him came chubby young Edgar Banta.

"Hey, Ira!" called the latter. "How long have you been back?"

"Couple of hours; I just finished unpacking. What's new around here? From the song, I take it the Old Boy is the same."

"Yeah; it's funny, too, because we've been cutting down steadily on his alcohol, but still he's soused. I don't see how he does it. What's new by you?"

"Oh, I saw a lot of people in New York—old Weintraub for one. He's the same old kidder—told me he'd been lucky to quit the directorship when he did, and razzed me unmercifully about the trouble I'd stepped into by taking the job. But he'll try to help us out with H.R. 1346. Then I saw my boy—he's got a job in the New York City high schools, you know."

"HOW'S THAT damned bill coming along?"

"H.R. 1346? It looked bad when I stopped in Washington. The *affaire Bemis* had quite an effect. People are saying that, if a scientist can discover something that would give him control

of the planet, the way Bemis' molds would have if Johnny hadn't interfered, the sort of thing ought to be discouraged.

"We thought it was very nice of the government to pass the McQuade Bill giving us all a handout to make up for our losses of income in recent years. But we forgot that there wasn't anything we could do if they changed their minds. And the Bemis business seems to have changed their minds. So they cut off the appropriation, and now they're going to pass this new bill stopping such grants in the future. When the Council of Eastern Universities finds that they have to cut expenses again, we'll be the first to catch it."

"Hell's fire!" snorted Banta. "Just when I'm getting somewhere with my protoplasm rejuvenation research. If I can keep going for another year, I can lick the problem and add 50 percent to the average human life. But if the money stops—the time and funds I've spent so far are just wasted."

"I know," replied Methuen. "You want to lick the problem so you can get a raise and get married; I want to get some income for the Station to bring the old place back to life. I suppose Johnny there is the only one who doesn't want anything. But cheer up, Ed; you can become a draftsman if you have to, and Johnny and I can join a circus."

Methuen erred in saying that Johnny didn't want anything. The bear had been listening; he was a natural-born eavesdropper. It was easy, because people so readily forgot that he understood them. And what Johnny wanted was to *know*. Now, Sarratt's behavior in the face of the reduction of his alcohol intake called for investigation. Johnny welcomed a little mystery; the Station had been rather dull since lack of funds had forced most of the scientists to leave. He put his book away and shuffled off toward the goat-pasture.

He found Sarratt peacefully snoozing on the grass on the edge of the pasture. A few feet away a billy goat cropped methodically. Johnny sat down to watch, far enough away not to alarm the animal. There was little sound but the snapping of grass-stems. The goat's nose came nearer the sleeping man's head. Johnny held his breath. To those stupid brutes anything that looked like grass was edible. Would it—

The little man awoke with a shriek, clutched his desecrated whiskers, and slammed a bony fist into the goat's face. The goat jumped back and galloped off, to resume its feeding at a safe distance. Sarratt muttered in his beard and went back to sleep.

Johnny experienced that warm feeling inside which, in human beings, is accompanied by laughter. Apparently the geneticist hadn't seen him. He trotted over to the shed and investigated it. Johnny suspected that the goat business was a blind; that the old man had a still concealed somewhere. But inside he found nothing suspicious. There were the simple equipment of animal husbandry, a few pieces of discarded scientific apparatus, a CO₂ container, a microscope, a pile of notebooks, a number of jars full of vinegar-flies, and a Sarratt mutator. This was a fairly simple machine for focusing beams of particles such as protons on the desired parts of the experimentee's anatomy. Johnny had a vague notion of how it worked; it hardly seemed usable as a still. He plodded out and watched Sarratt again, and presently dropped off to sleep himself—

TWO DAYS later he lay on the edge of the roof of the biophysics building, soaking in sunlight. So far, all the results that his snooping had produced were that Sarratt had let him into the shed while he made a blood-test on a newborn kid.

Below him, the Station's three re-

maining scientists (if you didn't count Sarratt) were earnestly conversing. Methuen said, "This is the worst news I've had yet. It not only looks as though H.R. 1346 were going through, but there's a move on to forbid all scientific research."

"But that's fantastic!" exploded Ryerson. —"They can't do that."

"That's what I thought. But it seems that, under the Twenty-fifth Amendment, they can."

"If they do," growled Ryerson, "the country's intellectual life will sink to the plane of barbarity that it has in some European countries."

"If I could get money enough to finish my protoplasm work," said Banta, "I'd fix that all right. People would be so grateful for those extra years that there wouldn't be any more hoocy about science, the destroyer of human values."

"Sure," said Methuen, "but how are you going to do it? I haven't any money, and neither has Eirik here. And there aren't any millionaires left—kind-hearted or otherwise. I ought to know—I've done enough fishing for endowments in my time."

Their eyes wandered dispiritedly around the Station. Would these fine buildings soon be deserted and falling into decay? Sarratt's song floated over:

*"If I had a cow that gave such milk,
I'd dress her in the finest silk;
I'd feed her on the finest hay,
And milk her forty times a day!
Ha-ha-ha, you and me,
Little brown jug; how I love thee!"*

Methuen sighed: "He's happy any way. I wish I knew how he did it. We've diluted the alcohol in his drinks down to zero, but it doesn't change his condition in the least. Of course he's one of those whose system absorbs alcohol rapidly and gives it off slowly, so that he can get lit more easily than most

people. But that doesn't explain his getting lit on nothing at all."

"What'll become of him when we . . . ah—" Banta left the sentence unfinished.

Methuen shrugged: "I don't know what you can do with them when they go to pieces at that age. By the way, Representative Flynn of Virginia is coming down here for a week. I invited him when I was in Washington. If anybody can head off H.R. 1346 he can, and maybe we can work on him while he's here."

"I hope," grumbled Banta. "God, how I hate the thought of going back to teaching!"

JOHNNY WAS still thinking of the incorrigible Sarratt. Somehow, he knew he had the clue to the mystery already; it remained to identify it and connect it up. The only book of fiction he'd ever enjoyed was a detective story. It dealt with the solution of a problem by reasoning; on that plane he and the author could really get together. Most fiction bored him; it dealt largely with human emotional crises. Johnny, not being human, had never felt those precise emotions, and found such works incomprehensible.

The song started again, and something clicked in Johnny's brain. It didn't seem possible, but if all the other possibilities were eliminated—

He landed with a thump on the concrete below, and headed for Sarratt's hangout. But hold on now; he'd have to go about this gradually. The first step was to get Sarratt so accustomed to seeing him that he wouldn't be noticed.

It was five minutes later that old Sarratt saw a large black bear curled against the side of his shed asleep. He thought of waking Johnny and ordering him away, but forbore. There wasn't any need of it, really; the goats were so used to Johnny that the sight and smell of him no longer frightened them.

Johnny was doing the same thing next day, when Methuen arrived with a well-dressed man whose prominent stomach contrasted with his youngish face. Johnny shook hands with him gravely. Sarratt bounced suddenly out of the shed, looking suspiciously at the two men. He relaxed when introduced.

"Mighty interesting place you'll find, Mr. Flynn," he said. "Course, 'tisn't what it used to be when we had plenty of money. But we do the best we can with what we have. Even I do, although I'm just supposed to be an old soak and no good for anything. Heh, heh!" he cackled at Methuen's embarrassment. "I'll show these young squirts who think they know all there is to know about science something yet!" He burped slightly, excused himself, and disappeared into the shed again.

Methuen, relieved to see the last of the old man, called "Come along, Johnny, will you?" and moved off.

Johnny wasn't pleased to have his investigation interrupted that way, any more than any scientist would be. But since it was Methuen, he came. The Station Director was meanwhile pointing out this and that to his guest, and thinking how fortunate they were in having Honoria Velez, who could do wonders in the way of cooking on a limited budget. If he could get Flynn to feeling good enough after dinner, maybe he could go to work on him. In theory he disapproved of practical politicians; but, he was mildly annoyed with himself to discover, he couldn't help responding to this specimen's infectious good humor.

Later, when Flynn had orated on the headache that the beer question was giving the people's representatives in Washington, and Johnny had demonstrated his mental accomplishments with pad and typewriter, Methuen gave his guest the works on the subject of government support of scientific research.

Flynn said, "Hm-m-m. You're ask-

ing us to take the unpopular side of a question. I'm not sure that I could really help you out, much as I admire you personally, Dr. Methuen. I'm not the president, you know."

"True. But you're chairman of the House Committee on Patents, which will have the say on H.R. 1346. And you're the most influential member of the Populist National Committee. I know that what you say goes with the Administration."

"Shucks, you flatter me. But just why should we take up this hyeah crusade of yours?"

METHUEN talked about the value of research to human welfare, mentioning Banta's protoplasm rejuvenation work as an example. Flynn, smiling blandly, replied: "Sure, that's all very true. But what's that got to do with me? Your business is science, but mine's politics. Don't misunderstand me: I have no objection to science. In fact the thing I like about you scientists is that naïve benevolence that don't take the prejudices of ordinary humans into account. Maybe it would be better if more folks was like you.

"But in my business you got to be practical, and that means not stickin' your neck out unless you can see some tangible advantage. Specifically, I meant just what was there in this project for the Populist Party in general and me in particular?"

"There's the prospect of having your life lengthened."

"I'm not old enough to worry about that yet. And Banta hasn't actually worked it out yet, has he? Then somebody else might discover a method of prolonging life, even if he didn't."

"But don't you see—" Methuen stopped, and knew he was licked. What had he to offer? Promises about the glorious future of the human race, which wouldn't win many votes in the forthcoming mid-term elections. He felt old.

Flynn could talk about the remoteness of age, but it didn't seem so far off to the gray Director.

SARRATT led a nanny goat into the shed and locked the door. He was a little startled to see Johnny curled up in a corner. Should he— But the bear seemed sound asleep. And, in his chronic state of happy befuddlement, Gordon Sarratt's critical faculties weren't over-sharp. He tethered the goat, put a bucket under it, and milked. Instead of milk, the animal produced a dark-brown liquid. Sarratt continued until he had a pint of the substance. He poured this into a stout stainless-steel flask, connected it to the CO₂ container, and opened the valve. There was a dull burbling sound for a moment, then the old man disconnected the flask again. Foam pushed out of the neck before he clapped a cap on it. He cooled it in ice water. Presently he drank, smiling between gulps.

So they thought he was just an old bum, did they? They thought he was all through, eh? Well, they'd think differently if they knew about this! And it hadn't been so difficult to modify a few cells in the goats to give a fermenting action. Just good old orthogonal mutation. And then all you had to do was feed the animals a little malt and hops with their grass. Result: beer. True, it was a bit warm and flat at first, but the CO₂ fixed that. And nobody could kick about its lack of strength! He'd like to ask that politician fellow in; he seemed like a good egg. But he didn't dare let anyone in on the secret for fear the sourpusses at the Station would interfere. Maybe he'd made a mistake by writing his nephew that letter. Damn it, he'd *have* to break this habit of thinking out loud. First thing you knew he'd give away the whole thing.

Say, this animal fermentation would kick up a rumpus if it got out, wouldn't

it? He'd been reading in the paper about the troubles in the beer industry, the racketeering, and the explosive proposal to make beer a public utility and have the government take it over. The toughest outfit seemed to be the Achilles Brewing Corp. of Chicago. Say, wasn't that the company his nephew was working for?—Sure—he was a salesman for it! By gum, that letter *had* been a mistake. Those fellows would stop at nothing. And if anything happened to this herd of goats, it would take years to develop another pure line like them. He'd never live that long. Oh well, why worry? Another mug of goat-beer would banish any apprehensions of the future.

Johnny waited until Sarratt was snoring and tried to sneak out. Unfortunately the door was still locked, and he couldn't quite see himself stealing Sarratt's keys and trying with paws and teeth to insert each in turn into the padlock and turn it. It was simpler to hook some claws into the neck of the lock and pull it off. The fact that it took a good part of the door with it was simply unfortunate.

He found Methuen looking gloomily at the ocean. Johnny was sorry; this was the only man for whom he had a real affection. He reared up and squawked his general interrogatory "Wok?"—Methuen explained his troubles.

Johnny fetched his pad and began writing. He hadn't intended to tell what he had just seen and heard; *his* curiosity had been satisfied, and he didn't like interfering in the mysterious relationships of human beings. But maybe his boss could make some pecuniary use of Sarratt's discovery.

Methuen read, whistled, and got up to do some investigating of his own.

LATER HE hunted up the politician. "Mr. Flynn," he said, "last night you were telling me of the trouble the beer

issue was causing you, between the gangsterism in the industry on one hand and the political capital that the Democrats and the few remaining Republicans would make of any public-ownership proposal. I believe your words were that it was worth your political life to take a stand on the question. Now, how would you like to have the whole thing settled without your having to pass any laws at all?" And he explained Sarratt's discovery.

Flynn looked incredulous. "But how can they do that?"

"Science. That old mascot of ours, Gordon Sarratt, was once the world's greatest geneticist. He discovered the principle of orthogonal mutation back in 1949, and was the first to develop industrial uses for the products of controlled mutation. Now he's gone a step further. I've tried the stuff, and it's good. A little unusual—but definitely good. Also potent."

Flynn roared with laughter. "A beer-goat in every backyard! I get you. But say, don't the gov'ment have exclusive rights to these goats anyway, under the terms of your contract under the McQuade Bill?"

"You forget that the government broke that contract when it cut off our appropriation last summer, so the clause about practical applications of our discoveries is invalid."

"I see. But isn't there some way we could get a monopoly? This thing looks too good to let go broadcast."

"I'm afraid not. Remember the patent statute of 1897, as revised 1930? 'Any person who has invented or discovered any new and useful art, machine, manufacture, or composition of matter, or any new and useful improvements thereof, or who has invented or discovered and asexually reproduced any distinct and new variety of plant, other than a tuber-propagated plant, not known or used by others in this country, before his invention or discovery

thereof' and so on. Even if we could get the supreme court to hold that a goat was a plant—which I greatly doubt—there's no argument about their reproducing sexually. And the genetical principles that Sarratt used in developing the beer-goat are either old or laws of nature—which are unpatentable."

"Too bad, Doc. As soon as somebody gets his hands on a pair of these goats, the thing's out from under our control. It's good, but not good enough, I'm afraid."

"Well, it would settle your political question. And maybe I could throw in an honorary degree. I know the president of Columbia pretty well."

"I *would* like one of those things. Tell you what. Do you play poker? Fine. We'll start a little game at eight tonight, and if you're ahead at midnight I'll undertake to swing the Party in favor of more subsidies to research, provided I get the degree, and provided this hyeah beer's really good stuff. If I'm ahead, I don't do anything—but I get the degree just the same."

"Hey, that's no fair. I'm pretty rusty, and you were probably born with a deck of cards in your hand."

"All right, damn it, we'll let one or two of the other boys in on your side. If any one of them stands ahead, I support research. Do they play?"

"Ryerson does; Banta doesn't. What is it, Johnny?" Methuen looked at the scrawl on the pad. "He wants to play too."

"What, you mean this hyeah *bear* plays poker?"

"Sure. Only it's better to have somebody else do his shuffling and dealing; he takes all night with those paws."

THE GAME started at eight—all the nannies in Sarratt's herd having been milked, despite the little man's protests, to provide refreshments. By eight-thirty a stiff wind drove gusts of rain against the windows. Flynn said, "Boy,

"I'm glad I'm indoors tonight. Who wants kyalids?"

"Five" said Ryerson.

Methuen swore under his breath. He was a cautiously mathematical player, and had been winning slowly. It hurt him to see the big ornithologist plunge that way.

"How abote you, Johnny?" The bear tapped the table three times, and Flynn shoved the cards across. Johnny held his hand between two toes of his left forefoot. One at a time he pinched three of these cards between the toes of his other front paw and lifted them out. He reversed the process with the cards he had drawn.

"Dealer's keeping what he has," said Flynn. Methuen called for one. On the first round of betting the two scientists dropped. Johnny and Flynn pushed the pot up a way before the former called queens over tens.

Ryerson bellowed, "Ho, ho! We thought you had a real pat hand! We'll know better next time. Another round?"

Flynn grinned and pushed the pot toward Johnny. All four (including Johnny, who held his glass in both paws) downed another pint of goat-beer. Flynn looked suspiciously at the others to make sure they drank as much as he did; they returned his scrutiny for the same reason.

At nine, rain descended in sheets. Methuen was ahead with Flynn close behind. Methuen realized that he'd been making mistakes in his calculations, probably as a result of the enormous amount of goat-beer they'd drunk. It was powerful stuff. He'd have to concentrate more closely. He thought sadly that he'd been mistaken in undertaking to out-drink a Southern politician. And that smooth devil probably knew it too.

At ten, Methuen was losing heavily; his mathematics stood up less well than

Flynn's all-around gambling experience. Ryerson had acquired a thick Norwegian accent.

At eleven Ryerson had dropped out, and was crooning a Norwegian drinking song to himself. Methuen, not much better off, tried to continue his play. Flynn was more Southern and jovial than ever. Johnny continued imperturbably to down his beer and signal for cards.

At one minute to twelve Methuen roused himself to look at his watch. "Last hand," he said, after what seemed to be difficulty in untangling his tongue from his teeth.

Flynn shoved in a small bet. Johnny raised a little; Flynn made a bigger raise. Johnny-dropped.

"Johnny, Ah'll never speak to you ag'in," moaned Flynn. "Just look what I had!" He threw down a full house.

"Of course he wasn't going to argue," mumbled Methuen. "He was ahead, and didn't want to risk his advantage."

"You mean to say this hyeah bear's actually beat me? Why, damn it all—oh, oh, looks like he is after all. What a disgrace to the house of Flynn! Don't you go tell nobody, Doc. I'd never live it down. Ain't nobody going to know. Ain't—what's that?"

FROM SOMEWHERE came a snarling command, "Keep your hands up and your trap shut. Where's everybody else around here?" There were unintelligible words in Sarratt's shrill voice, and the scuffing of many rubber-soled shoes. A door burst open, and the players were looking into the muzzles of rifles and submachine guns, held by handkerchief-masked men in raincoats and oilskins. "Outside, you three!" snapped one of them.

Three? thought Methuen. He looked around. Johnny had apparently evaporated. Of course, he might have slipped out the dining-room door. The

three obeyed, their protests silenced by the poke of gun muzzles.

Outside, they found Sarratt and Banta in pajamas, and Mrs. Ryerson in a fancy nightgown. Methuen counted nine raiders. Two more appeared. One said to the heavy-set man who seemed to be the leader, "There's nothing over there but cages with a bear and some monkeys and things in them." The other drove before him, like a vast black cloud, the invaluable Honoria—who evidently had simple ideas about sleeping costume. The visitors laughed loudly, and the cook muttered threats.

The raider who had poked around the cages with a flashlight had discovered Johnny in a cage which, at the first alarm, the bear had remembered to be empty. He sat up and assumed the idiotic open-mouthed pose of a bear begging for peanuts. The raider departed without thinking to see whether the cage door was locked.

Now, Johnny couldn't see much because of the position of the cage, but he could hear.

"Where's them goats?"

"What goats?"

"Don't try to stall—they goats that give beer."

"What do you want with them?"

"None of your damn business. Will you say where, or do I have to use a lighted cigar on you?"

"They're—"

Johnny slipped out of his cage and raced for the pasture. Warm rain blew into his face. Sarratt would have put his pets under cover on a night like this. Johnny made his way into the shed, and felt and smelled his way around in the pitch darkness. A row of stalls ran along one wall. In the first stall he pushed the bleating animal aside, took two turns of the steel chain around his foreleg, and pulled. The woodwork to which the chain was fastened came apart with a rending sound. In a few minutes all but four of the goats had been

freed. He'd have to leave those for the thugs to find, so they'd think they had them all.

When a group marched up the path to the shed, flashlight beams darting ahead, Johnny had tossed the bewildered goats bodily over the pasture fence in quick succession. He was now running behind the herd, accelerating by bites and cuffs their flight into the hills. Behind him he heard four shots. He looked back, and presently saw the stabbing needles of light receding toward the main buildings. The remaining goats were safe, then, unless somebody made a break about how many should have been in the shed. He trotted back cautiously, and arrived behind the biophysics building to hear the rasping voice of the leader: "... we ain't gonna hurt you none, just tie you up so you can't do nothing until tomorrow. You stay nice and quiet and you'll be all right. But if we have any trouble getting away, we'll bump you off if it's the last thing we do."

Johnny thought rapidly. The obvious thing was to wait and release his friends when the gangsters had gone. But they'd probably come in a boat. If they knew their business, they'd have landed, not at Frederiksted, but on the beach at a point near the Station. If he could get to that boat before they did—

HE SKIDDED down the steep grassy slope onto the beach. The wind had fallen, but there were still a few drops of rain in the air. Small breakers glowed briefly with phosphorescence as they tumbled and died. Johnny plodded along the sand and broken shell, thankful that the surf would drown any noise he made.

A fishy smell excited him. It *might* be just a dead shark, but again it mightn't. As it grew stronger, he made out a shape only slightly blacker than its surroundings. A sudden yellow gleam made him jump; it hung in the air, then

oscillated violently and went out, leaving a tiny red spot. Evidently somebody had lit a cigarette. Coming closer, Johnny made out the smoker's hunched figure perched atop the cabin.

He slipped into the water, thankful for the invisibility conferred by his sable coat. The craft was an ordinary fishing vessel with a low stern. Johnny climbed onto the quarter-deck, and thence onto the cabin roof. What method should he use? If he could grab the back of the man's neck he could probably break the spine with one bite; but the watcher was wearing a sou'wester, which would hinder his getting a good grip. If he made a noise, he'd turn, exposing the throat—but that would give him a chance to bring his gun into action. The best way was evidently the simplest. Johnny reared and raised a paw high over his head.

Ten minutes later the corpse had been safely stowed in the bushes back of the beach. On the cabin roof sat Johnny, the sou'wester on his head, the oilskin around his shoulders, and the heavy automatic rifle in his paw. He hoped nobody would notice the fragments of brain spattered around. Flashlight beams flickered down the beach; one shot out to the boat. In a moment the eleven men were piling in and shoving off with much splashing and yelling of orders. A couple of them shouted at Johnny, but otherwise paid him no attention.

The engine coughed and started. The boat backed, swung around, lurched through the breakers, and settled down to a steady *oomph*—pause—*oomph*—pause as it headed into the short swell.

Johnny was thinking furiously. He hadn't wanted to start anything on or near the shore, for fear the gang would carry out their threat against the scientists. But what was he to do now? They'd put their shoulder-arms away, but most were still wearing pistols in holsters. If he could talk, he could drop

down and order them to surrender and head for Frederiksted. But he couldn't talk, and if he showed himself they'd begin shooting on general principles.

Or, he could simply jump down onto the quarter-deck and open fire. If he could get them in a bunch, with the rifle set for full-automatic fire, he might be able to mow them all down. But on a boat of this size there were too many things to dodge behind. There was no light outside of a small one in the cabin. He might get a few of them, but—eleven to one!

So far as killing them went, Johnny had precisely as much hesitancy about destroying eleven enemy men as the eleven enemy men would have about destroying a black bear. But the minute he made a hostile move, he'd precipitate a general gun fight, with the odds hopelessly against him. And he hated being shot at under any circumstances. The memory of how one of Bemis' crew had bounced a bullet off his skull still made his head ache.

To starboard, the lights of Frederiksted shone wetly over the intervening quarter-mile of water. If he tried to swim ashore after they got out of sight of the town, he'd probably get turned around and try to swim the whole length of the Caribbean. He couldn't afford to stay where he was until dawn, and be discovered when they were half-way to Cuba.

The raiders had gone in. Sounds filtering up through the cabin roof implied that they were relaxing in their own peculiar way. A yachting-capped head popped over the edge of the cabin roof, and bawled, over the whine of the breeze, the swish of the waves, and the subdued roar of the motor: "Hey, Angelo, come on down and have a drink!"

JOHNNY KNEW he'd have to think quickly. He began to feel plain, cold, tingling terror. Why had he come

chasing after these gangsters? Hadn't he done enough by saving the goats?

"Whassa matter? Do we have to come up and get you?"

Johnny's brain worked at a speed that would have burned out its bearings if it had had any bearings. Then he got to his hindlegs, holding the radio mast to steady himself: "O. K., Angie!" yelled the face, and it was gone. Johnny shrugged off the oilskin. Gripping the rifle, he lowered himself over the side of the cabin onto the catwalk, and inched aft, digging his left foreclaws into the canvas lest a sudden roll pitch him into the Caribbean.

do about this hole? It's big enough to put ya foot through." "She's gonna sink in a few minutes. Head for shore, you dope!" "But they'll pinch us—" "Nev' mind 'at. 'S betta 'n being food fa shoks!" "Hey, I can't swim!"

Johnny turned toward Frederiksted and struck out. *He* certainly hoped that there were no hungry or inquisitive sharks around.

At two o'clock, an automobile swept up to the Biological Station. Out of the front climbed two large black policemen; out of the rear came square, brick-red Peder Uldall, chief of the Frederiksted police, and Johnny Black. They



At the after end of the cabin, without showing himself, he swung the rifle up so that it pointed at the floor of the quarter-deck. He hooked a claw around the trigger and pulled.

With a thunderous roar the rifle poured its forty shots through the bottom of the fishing boat. In eight seconds the mechanism gave a final click. Johnny tossed the rifle into the black water and hurled himself after it. When he came up, the boat was standing by, fifty yards off. A searchlight swung, and there was a continuous crash of gunfire. A bullet plunked a few feet from his head. He ducked under and paddled away for some seconds. When he judged himself safe, he stuck his head up.

The wind blew scraps of speech: "Didja see it? A big black thing—didn't look human!" "What we gonna

released the seven bound, gagged, and blindfolded human beings in the Recreation Room. Commissioner Uldall lent Honoria his raincoat to cover her nudity; unfortunately such was her girth that it didn't meet in front. He explained: "Sergeant Oglethwaite here had the desk tonight, and all of a sudden this bear of yours comes running in, soaking wet. The sergeant was a bit surprised, like anybody would be, only he knows the bear is supposed to be tame. Well, this bear sits down at the typewriter and pecks out with his claws about how the Station was held up, and about how he sank the gang's boat outside the harbor, and that they'd be swimming ashore pretty quick. Oglethwaite wonders if he or the bear was crazy, but he figures it wouldn't hurt to go see. So he takes a cop and goes down to the water front, and sure

enough, there's one of these hard-looking parties crawling out on the beach like he was all in. They rounded up nine of 'em; they say there was two or three more, but they must have gotten drowned. One of 'em is Knucks Bettendorf, a Chicago gangster in the beer business. You folks better come down and identify the rest of these guys right now, so we can hold them."

AT THREE, an occasional starbeam poked hopefully through the thinning clouds. Methuen and Flynn headed for their rooms. "Thank God that's over," said the former, yawning. "We've got to get up early to organize a goat hunt, to round up those that Johnny chased into the hills. By the way, Johnny, how did you get on the track of Sarratt's invention or whatever you call it?"

The bear delicately scratched the word "song" on the floor.

"Song? Oh I see: 'If I had a cow that gave such milk.' Of course!"

Flynn said, "Now I'd like to ask something. I can't understand how Johnny could drink me down so he could beat me at poker. I was practically *weaned* on whiskey, you know, and beer's just like soda-pop to me."

Methuen grinned. "You forget, old man, that Johnny weighs three times as

much as you do. It takes three times as much liquor or beer to produce a given concentration of alcohol in his blood as it does in yours. You should have insisted on his taking three drinks to your one."

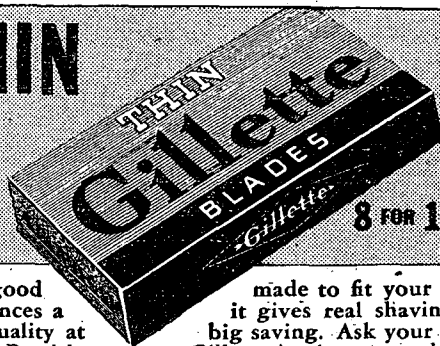
"Well, well, I never thought of that. I guess you scientists are pretty smart people, at that. By the way, you remember that you promised me a degree, even if you won the game."

"Sure, you'll get it. But it seems to me that Johnny ought to have one too—he discovered Sarratt's secret, won the game, saved the goats, and captured the gang. He certainly should get some credit for the revival of science, when and if it takes place."

The president was talking in enthusiastic but vague terms about Johnny Black's services to science, while the subject of his discourse stood before him, robed and capped, ignoring the snicker-punctuated buzz that ran through the audience.

"... the degree of Doctor of Science, and all rights, privileges, and prerogatives pertaining thereto." Johnny took the scroll, bowed, and waddled off the platform on his hindlegs. He had at last found an advantage in not being able to talk: nobody expected him to make a speech on this occasion.

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Telescopes vs. Cameras

by

H. A. LOWER

The 200" Mt. Palomar telescope is better because it gathers more light. But—how about making a photographic plate that needs less light? Wouldn't that be a far cheaper, better way of getting the same result?

WHEN Galileo experimented with lenses and succeeded in producing an "Optic Tube" which magnified about nine diameters, he really started something. Not satisfied, he promptly built another—bigger and better than the first. He had the bug already. From that time on, astronomers have never been satisfied. Scarcely is one telescope finished and in use than they begin wishing and planning for another. No matter how excellent the instrument, or how well it does the job for which it was designed, new problems develop and new instruments are demanded to solve them.

From Galileo's "Optic Tube" to the 200" Palomar telescope is a long and rocky road, and the end is not yet in sight. To even try to enumerate all the rocks over which astronomers and telescope builders have stumbled while making their way along that road would require a good size book. But difficulties add to our knowledge, and each obstruction serves as a challenge to someone's ingenuity. The fringe of color around objects seen with the early refractors was one of the first of these challenges to man's resourcefulness. Lacking the knowledge of why it happened or what was needed to improve the refractor, chromatic aberration was too big an obstruction to surmount, so by the inven-

tion of the reflecting telescope astronomers detoured around it.

As a mirror reflects all colors equally, the new instrument did not suffer from chromatic aberration, but it was not long until another objection appeared. The first reflectors used mirrors with a spherical curve, and, unfortunately, a spherical surface will not reflect light from all parts of the mirror to one point. When an attempt was made to build more powerful reflectors, it was soon evident that a different curve was needed.

Long before the time of Newton men understood geometry, and the application of geometry to the new science of optics showed at once that the required curve was a parabola. Fine! Now all that was necessary was to change the curve of the mirror to a paraboloid of revolution and the problem would be solved. But it was not so easy to do. Theoretically, all that was necessary was to polish away the center of a spherical mirror until a paraboloidal figure was obtained. But how could the telescope maker know when he had polished enough? No known instrument was capable of measuring the difference between a spherical mirror and a parabolic. All that anyone could do was to polish a while, then try it on a star. If it gave sharp images, fine. If it did not,

The Problem

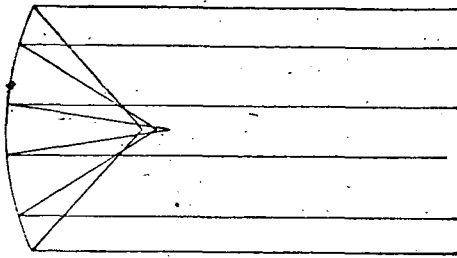


Fig. 1. The aberration inherent in a spherical mirror. Those rays entering away from the center of the mirror are not brought to the same focus, resulting in a fuzzy, imperfect image. But mirrors have only one surface to be ground, and that will reflect all kinds of light, including ultraviolet.

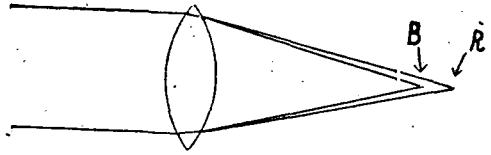


Fig. 2. Chromatic aberration of a single lens. The blue light is brought to a focus nearer the lens than the red-light-focus, again resulting in fuzzy images. But lenses, further, have two surfaces—at least—which must be ground, and glass is opaque to ultraviolet. If chromatic aberration is corrected, two lenses with four ground surfaces must be used, made of two different types of glass which produce opposite aberration effects.

The Telescope

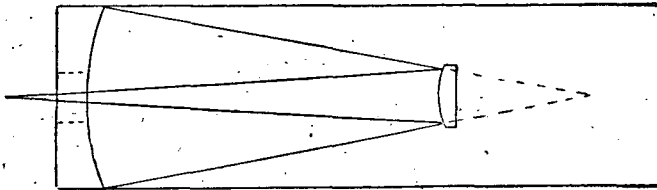


Fig. 3. Visual Cassegrainian reflector. Satisfactory for visual work, but the image is corrected to produce sharp images at the center of field, where the human eye works. But at the edges of the field—included by photographs—the images are as railroad spikes to pins.

Two Solutions

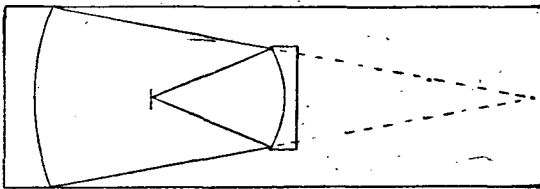


Fig. 4. The Schwartzchild reflector described in the text, with correcting mirror using new curves—so-called "bows"—that can be described only mathematically.

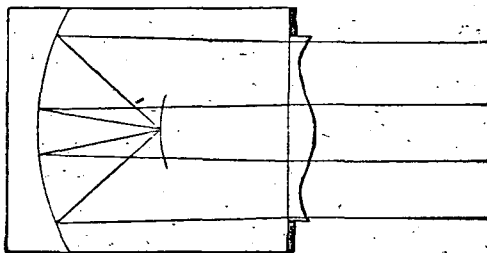


Fig. 5. The Schmidt Camera. The curves of the correcting lens are exaggerated for visibility. Each of these correcting methods makes it possible to secure images sharp and clear over the entire field of the plate.

go back and polish some more. Not a very scientific way of making a telescope, but some of the early craftsmen developed astonishing skill at it.

Meanwhile, other men still had faith in the refractor, but the refractor also suffered from spherical aberration. In an effort to avoid both chromatic and spherical aberration, lenses with shallow curves were tried. This helped, but it resulted in long-focus instruments which were difficult to handle. The early astronomers were true enthusiasts, and in the effort to learn more of the secrets of the heavens they built refractors 100, 150, even 200 feet in length. Such instruments would seem absurd nowadays, but then they were the best obtainable—and in spite of the inconvenience and difficulty of pointing such monstrosities, good work was done with them and new things were learned. In the able hands of Huygens and Cassini, telescopes of this type solved the mystery of Saturn's Rings.

TELESCOPE makers have ever been alert to snatch at each new scrap of knowledge which would enable them to improve the instrument they love. A list of the great minds which have contributed to the constantly growing science of optics would read like a Who's Who of science. Astronomers and mathematicians, physicists and glass makers, chemists, machinists and many others have each added a bit to the store of knowledge on which we draw when we build a telescope. Sometimes one man, by a brilliant invention, has advanced the art by a long jump. Such a jump was made when Foucault invented a means of testing the curve of a speculum. Before his time, mirror makers worked "by guess and by gosh", and the modern telescope maker wonders how they succeeded in "guessing and goshing" as well as they did.

But Foucault changed all that. Now

the curve of the speculum can be seen and measured with great accuracy. It is actually possible to see an error of one millionth of an inch in the curve of the mirror, and an error that can be seen can be removed! (Though the tool most needed is apt to be patience.) Needless to say, the reflector at once took a long lead over its rival, the refractor.

But the refractor was not out of the running. Men had been learning how to make better glass; how to combine two lenses of different kinds of glass so as to overcome the chromatic aberration which caused the rainbow colors around the images of planets and stars. Reams of paper had been used in trying to figure out combinations of curves which would correct spherical aberration. No one man could claim all the credit, but bit by bit knowledge was accumulated and the refractor improved. Soon it was seriously challenging the reflector again. The reflector still held the lead in size, for it was easier to cast a large disk of speculum metal than it was to make large disks of glass perfect enough for a lens.

Speculum metal was a white bronze, hard, and almost as brittle as glass. It could be ground and polished to a beautiful optical surface, but it had one fault. It tarnished. When a speculum became tarnished it was necessary to repolish, and that could only be done by a skilled optician, as the least bit too much polishing at any one spot would change the accuracy of the curve. When freshly polished, speculum metal reflects from 50% in the violet to 70% in the red. But light loss rapidly increases as the surface tarnishes. Loss of light due to the lenses of a refractor absorbing and reflecting light is considerably less, and as long as the lenses are kept clean, this loss does not increase. Advocates of the refractor claimed that a 26" refractor was fully equal to a 6' reflector. Reflector enthusiasts denied that the case was quite that bad, but it was generally

admitted that the refractor gave the brighter images.

Astronomers should have now been happy. Both the refractor and the reflector had been improved until spherical aberration was eliminated. Chromatic aberration no longer seriously affected the sharp definition of the refractor. Possibly astronomers were satisfied for a little while. In an *Astronomy* which was published in 1879 I find this statement: "Difficulties innumerable arise as we attempt to enlarge the instruments. These have been overcome, one after another, until it is now felt that the best modern telescope, with an object lens of 26", has fully reached the limit of optical power."

FOR THOUSANDS of years men had argued about the movements of the planets. Why did the Sun rise and set? Why did the stars shift with the changing seasons? How explain the seasons? In short, what made the wheels go 'round? Visual observations supplied the answers. The nature of these observations was not greatly different from those made before the invention of the telescope. The telescope had merely increased the power of the eye, but this increase in visual power had solved most of the problems of the Solar System. The size, distance and motions of the planets were now known with considerable accuracy. Astronomy of position had become an exact science. All this had been accomplished with telescopes which were designed solely as *aids to the eye*. The telescope builders had done a fine job; astronomers felt that most of the important discoveries had been made. About all that remained for the future was to improve the accuracy of what was already known. The secrets of the stars would probably remain secrets. The stars were too distant for man to ever learn much about them.

This comfortable state of affairs was rudely disturbed by two new develop-

ments: the spectroscope and the camera. There is no need for me to point out to the readers of this magazine the importance of either of these new tools of science. Everyone knows that the result of these developments was an immediate enlargement of the astronomical horizon. The problems of the Solar System were either solved, or well on the way to solution. Now the astronomer looked beyond the farthest planet, to the stars and the nebulae. No longer were the stars to keep their secrets, or the nebulae to remain mysterious. Astrophysics was born.

Naturally, astronomers were delighted with the new tools. But for the instrument maker it was just another headache. Telescopes designed for *visual* use, and considered practically perfect, were not so good when used for *photography*. Refractors were achromatized for the visual rays. Actinic light, which affected the photographic plate most strongly, had been disregarded when the opticians computed the lenses. In order to get sharp photographs it was necessary to use yellow filters and restrict the range to the light which affected the eye most powerfully.

The reflector, of course, was perfectly achromatic—but its field of sharp definition was quite limited. The eye could only take in a very small field, directly on the optical axis. But the photographic plate, being so much larger than the pupil of the eye, should be able to cover a much larger area.* When photos were made with reflectors, the stars in the center of the field were beautifully sharp and distinct, but only a little way off of the the optical axis the images began to deteriorate. *Coma* put tails on the stars. *Astigmatism* further messed them up until the star images at the edge of the plate looked like comets.

*So narrow is the vision field of the human eye that it is impossible to look at both eyes of a man four feet away at the same time. Compare this with the performance of a camera plate that records the whole man in perfect detail at one "glance".—Ed.

airplanes or butterflies. In this respect, refractors were only a little better than reflectors. They also suffered from coma and astigmatism, although to a somewhat lesser degree. Obviously, something had to be done about it!

Something was done about it, but not for some time. Opticians needed more knowledge of lenses. Photography needed time to grow. Meanwhile, telescopes continued to improve. Refractors became larger; reflectors were no longer made of speculum metal. Some one had discovered a method of silvering glass, and mirrors were now made of glass and given a shining skin of pure silver. This silver film reflected light more efficiently than speculum metal, and when it became tarnished it could be removed with acid and a new film deposited in a few hours. It was a simple chemical process, and did not endanger the delicate curve of the acid-proof mirror. Perhaps I ought to qualify that last statement. At first, the silvering process did endanger the mirror, and that very fact resulted in an improved silvering method. The first formula required that the mirror be warmed in order to make the silver deposit on the glass, and this resulted disastrously when Brashear tried to silver his first 12" speculum. A cold draft blew across the warm mirror—and the glass shattered to bits. Brashear and his wife were heartbroken at the loss. The next day they were at work making another mirror. By the time the new mirror was finished Brashear had learned how to silver glass without the use of heat.

PHOTOGRAPHY grew slowly with the passing years. Photographic chemistry provided better plates; lens designers improved lenses. But the new lenses were not made for photographing the stars. It was much more important to be able to make snapshots of the baby. Baby wouldn't hold still long enough for time exposures; so faster plates and

faster lenses were demanded. In the effort to meet this demand, opticians learned a lot about optics. Chromatic and spherical aberration, coma, astigmatism, curvature of field—all these, and more, plagued the camera makers. Microscope builders were also having their troubles, and the efforts to solve their problems helped to add more facts to the growing heap of optical information.

One of the first real photographic telescopes was made for Barnard by Brashear. This instrument was not much different—except in size—from the lenses used by portrait photographers of that time. It was of the Petzval type and employed four lenses in order to correct the various aberrations—for opticians had learned that many optical surfaces were necessary if aberrations were to be corrected over a wide area. Each surface meant additional work for the optician, and more cost for the purchaser, but the results justified it. With this instrument, an extensive program of photography was undertaken. The star clouds of the Milky Way, and particularly the obscuring clouds, or dark nebulae, interested Barnard. Exposures ranged from four to eight hours, so any asteroid that happened to be in the field betrayed itself by its motion. Although Barnard was not particularly interested in asteroids, dozens of asteroid trails were found on his plates. Before the invention of photography, asteroid hunters had to check each object in the field against a star chart, an extremely laborious task. With the development of photography, asteroid hunting was on a quantity production basis, and new discoveries soon had the orbit computers swamped with work.

The success of wide-field photographic telescopes in the search for asteroids and comets indicated that an instrument of this type was needed at Lowell Observatory to search for the trans-Nep-tunian planet which Dr. Lowell had predicted.

A 9" photographic telescope made by Brashear was loaned by the Sproul Observatory, and hundreds of photographs were made with it. But it became evident that a larger and more powerful instrument was needed. Early in 1929 a 13" camera was obtained and work continued with this new instrument, which gave fine definition over a 14" by 17" plate. For nearly a year the photographic work resulted in nothing more exciting than the discovery of numerous asteroids. But on February 18, 1930, on comparing two plates made on January 23rd, and January 29th, the long-looked-for planet was discovered. (Incidentally, the search for Pluto resulted in the discovery of more than 500 asteroids, each one of which confused things and might have been mistaken for the predicted planet, had the work been in less skilled hands.)

IT IS unnecessary to go into details regarding the construction of photographic telescopes of this type. They do not differ in essential detail from ordinary cameras with which we are all familiar. True, these instruments are larger, and very carefully figured, to give the finest possible definition, but they are just cameras, for all that. While any telescope can be used as a camera, many astronomical cameras cannot be used visually, so it is really more accurate to call them cameras than telescopes. Many small cameras are also used for astronomical photography, for hunting comets, and to photograph meteors. Some observatories maintain patrol cameras which are in use on every clear night, just to keep a check on what goes on in the heavens.

Did any of you ever take an astronomical photograph? In case you haven't, I can tell you it is not a very exciting job. The camera, of course, must have an equatorial mounting and must be driven at the proper rate to follow the stars. As

no mechanical drive can be trusted to follow accurately enough for a long exposure, the astronomer has to sit for hours with his eye glued to a guiding eyepiece, keeping a pair of crosswires carefully centered on one particular star. If the guiding is carefully done, a fine photograph may result. But if the night is cold, chilblains and a cold in the head may also result. Naturally, no true scientist is ever influenced by considerations of bodily discomfort, but, nevertheless, fast cameras interest the astronomer just as much as they interest the most rabid of the candid camera fiends. A fast instrument will permit shorter exposures—or with the same exposure it may reach fainter objects. In either case, more can be accomplished in one night.

This brings us to the question of photographic speed, and how it may be obtained. The photographic chemist is doing his share by providing faster emulsions, and emulsions which are sensitive to a wider range of wave lengths. The lens designers have speeded up the camera by producing faster lenses; that is, lenses with a shorter *F* ratio. Every camera fan knows that the *F* rating of his lens is an indication of its relative speed, but those who are not real camera nuts may not know just what it means. *F*/6.3, *F*/4.5 or *F*/2 is just a convenient way of indicating the ratio between the diameter of a lens and its focal length.

Focal length controls the size of the image which a lens produces. The diameter of the lens determines the amount of light which is available to produce the image. If the diameter of a lens is increased, without changing the focal length, the size of the image remains unchanged. But the amount of light available is increased and we have a brighter image which will register on the plate in less time.

Photographic lenses are afflicted with

seven major aberrations and a number of minor ones. It is not possible, even in an optical system containing many surfaces, to completely eliminate all these aberrations. The best that can be done is to select the aberrations which are most detrimental to the purpose for which the instrument is to be used, and reduce them to a satisfactory minimum. If the lens must be fast, and also cover a wide field, the problem is more difficult. Lens designers have done a wonderful job in producing fast lenses with aberrations so well corrected that definition is really excellent. But in order to do this, lenses must be made with deep curves, and employ a number of elements. This means that the lenses are thick and comparatively heavy in proportion to diameter.

MODERN miniature cameras are available with lenses of $F/2$, $F/1.5$ and, in some cases, even faster. With the newer fast films they will almost make snapshots of the proverbial black cat in a coal cellar at midnight. It looks as if the lens designer should be able to supply a lens which would satisfy the most exacting astronomer. But the astronomer usually wants a *big* lens, and these fast cameras are typically "miniature" cameras. The focal length is usually measured in millimeters—and astronomers are accustomed to thinking of focal lengths which can be measured in inches or even feet.

Well, suppose we make a lens big. For example, let us take a modern $F/2$ lens and enlarge it in all its dimensions until its diameter is equal to that of the greatest refractor in the world, the 40" at Yerkes. Such a lens would have a focal length of 80" as compared to 62" for the Yerkes telescope. Theoretically, it would be able to produce as dense a negative with an exposure of four minutes as the great refractor would in five hours and forty-two minutes. But actually it would not work out that way. The new lens would be so thick, and the losses

due to absorption and to reflection at the various surfaces would be so great that the speed would be cut down much below that indicated by the focal ratio. In addition, even if it were possible to cast the glass disks of the necessary quality, the lens would be enormously expensive. Evidently lenses of this type are not the right answer.

Size for size, reflectors are less costly than refractors. It is easier to cast glass disks which are satisfactory for making reflectors, as the light does not have to pass through the glass and minor defects such as bubbles do no harm so long as the optical surface does not cut into them. The main mirror of large reflecting telescopes is usually $F/5$, so the reflectors are already pretty fast. But several methods may be used to make them faster.

As a first tentative attack on the problem, we might investigate the silver film. Does it reflect light as efficiently as is desirable? Unfortunately, it does not. The spectroscope shows that while silver reflects quite well throughout the visible range of the spectrum, it has a bad hole in the near ultra-violet. This is a part of the spectrum which affects a photographic plate quite strongly. In fact, silver leaks so badly in the ultra-violet that sometimes a silver film is used as a filter when we want to take a photograph with ultra-violet only.

Various methods have been tried for coating mirrors with metals other than silver. One of the most successful is a method perfected by Dr. John Strong for coating mirrors with aluminum. It is not as easy to aluminize a mirror as to silver it. Silvering is a chemical process, and requires no elaborate equipment. But to aluminize a mirror requires electrical equipment, high-vacuum pumps, and, for the operator, a thorough understanding of laboratory technique. Briefly, the process requires that the mirror be perfectly clean, sealed

in a bell jar which is evacuated to a pressure of about 10^{-4} mm of mercury, and exposed to the vapor of aluminum, which has been vaporized by electrically heated tungsten coils. Metallic aluminum is condensed on the mirror in the form of a thin, bright film, which needs no polishing. When the aluminum film has been deposited and air is admitted to the bell jar, a film of oxide begins to form. Presumably Al_2O_3 or $\text{Al}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$, practically the equivalent of sapphire, this film is transparent and superlatively hard, yet so tough that it will protect the soft aluminum, even when washed with ordinary soap and water.

If two mirrors were placed side by side upon a table, one of the mirrors freshly silvered, and the other coated with aluminum, they would appear equally bright to the eye. Even when used in a telescope it would be difficult to detect any difference until the instrument was used for photography. Then the aluminized mirror would be found to be about 40% more efficient. This is a worthwhile improvement, and it can be applied to telescopes already built, at comparatively small cost. In effect, it makes the 100" Mt. Wilson telescope as effective as a 120" silvered mirror.

SEVERAL different methods have been tried in the effort to widen the field of sharp definition of the reflecting telescope. Geometry proves that the parabola is the best curve for a telescope using a single mirror. But if more than one mirror is used, it is possible to improve definition at the edge of the field by the use of new curves. G. W. Ritchey and a French mathematician named Chretien worked out a system of curves for a compound telescope of the Cassegrain type which will give good definition over a considerably wider field than the conventional Cassegrain. These new curves are not conics, and can only be defined mathematically.

Technically, these new curves are known as "bows".* The largest instrument of this type so far built is the new 40" Ritchey-Chretien telescope of the Naval Observatory at Washington.

The distinguished German astronomer Schwartzchild worked out the mathematical theory of another telescope which uses curves similar to the Ritchey-Chretien. However, his telescope employs a concave secondary mirror, while the secondary of the Ritchey-Chretien is convex. The secondary mirror of the Schwartzchild is located inside the focus of the primary mirror, and shortens the focus. The secondary of the Ritchey-Chretien is similarly located, but due to its convex surface, its effect is to lengthen the focus. The Schwartzchild telescope has a flat field, but the field of the Ritchey-Chretien is curved, and in order to have sharply focused images the plates must be curved to the same radius. Schwartzchild never made a telescope of his new type, and, so far as is known, the only instrument of this type yet built is a new telescope which has just recently been completed at the University of Indiana.

Many astronomers did not look with favor upon these two types of telescopes. They were instruments for special purposes, and the usual observatory telescope had to serve for various purposes. Sometimes the job required a short-focus instrument which gave small, bright images. Sometimes a long focus was needed. The Newtonian type worked fairly well when a short focus was required, and by the addition of a small,

*Mr. Lower does not give an adequate idea of what those curves are. "Bows" is far too mild a term for them. The mathematics of their surfaces are on an easy par with some of Einstein's more esoteric manipulations. A man can understand what a paraboloid looks like, and, being a more-or-less normal curve of revolution, they aren't hard to grind. These correction mirrors have surfaces that can be conceived only in the form of a mathematical expression—provided you are sufficiently advanced to have the ability to get pictures from mathematical expressions. That is, if $(x/2)^2 + y^2 = c^2$ makes a picture of a geometrical figure in your mind, without translating it into English, then you *might* learn to picture one of those correction-mirror curves. —Ed.

convex hyperbolic secondary it could easily be converted to the Cassegrain form, which gave a long focus. Usually, two or more secondaries were provided, so a number of focal lengths were available. This makes a very useful and flexible instrument, and as the field of good definition can now be increased by the addition of a comparatively small correcting lens designed by Dr. Frank E. Ross, it leaves little to be desired. The Ross correcting lens is located just a short distance in front of the photographic plate, and has practically no effect on the focal length of the instrument. It merely corrects coma, and so gives sharper star images at the edge of the field.

THE NEAREST of the great spiral nebulae, M31, in Andromeda, has been studied extensively with the 100" telescope. With this, the world's most powerful telescope, it is possible to reach some of the brighter stars in the outer parts of the nebula. Much of the nebula cannot be resolved, even with this powerful instrument. M31 is at a distance of about 700,000 light years. To the naked eye, it appears as a faint misty spot, about half the size of the Moon. On a photograph made with a camera having a focal length of eight inches, it appears as an elliptical object about a quarter of an inch in length. Measurement shows it to be about five times as large as it appears to the eye, for the camera records the faint outer parts which cannot be seen, even with the best telescope. Now an image only a quarter of an inch in length shows some detail in the nebula, but no stars can be detected. Only when the image is greatly magnified can we detect the stellar structure.

When photographs of M31 are made at the Cassegrain focus of the 100" telescope, the image of the nebula would be about six feet in length. Of course, the telescope cannot cover so wide an area, so the nebula can only be photographed

piece by piece. Many photographs are needed in order to study the entire nebula, and as exposures are fairly long, much time is consumed. A more powerful instrument would be welcomed by the astronomers.

Far out in space are other nebulae. M31 is the *nearest*. Many of these other nebulae are so distant that even on photographs made with large instruments, the images are very small. When it is desired to photograph the spectra of these faint nebulae, lenses of very short focus are used with cameras of special spectrographs. A lens designed by Dr. W. B. Rayton has a focal length of 32mm, and a focal ratio of F/.59. Another lens, designed by Mr. R. J. Bracey, has the remarkable focal ratio of F/.36. Used with special spectrographs attached to the 100" telescope, lenses of this type have done much work on the radial velocities of the distant nebulae. When the 200" telescope is completed, much of this work will be turned over to it, for it should reach still farther out into the depths of space.

The 200" telescope will not differ greatly from the 100", except in size and focal ratio. It will be faster, both because of increased light-gathering power, and because the focal ratio will be shorter. The main mirror of the 100" is F/5. The use of a Ross correcting lens will permit the focal ratio of the 200" to be F/3.3 and still have an adequate field of sharp definition. Without the Ross corrector, the field of sharp star images would be less than an inch in diameter. Astronomers are anxiously awaiting the completion of this greatest of all telescopes, as there are problems of the distant nebulae which cannot be solved by any lesser instrument.

It is difficult for most people to appreciate the great size of the 200" telescope. The mere statement that the mirror is a disk of Pyrex 200" in diameter, or that the moving parts of

the telescope will weigh 425 tons, does not convey an adequate idea of what this telescope will be when finished. For the first time, a telescope will be so large that the observer will actually ride inside the tube when observing at the Newtonian focus. The bullet-shaped housing in which the observer will sit—equipped with a comfortable chair which will always remain upright, and with all necessary controls within easy reach—will obstruct less than ten per cent of the total area of the great mirror. Yet this observer's cage will be larger than the mirror of the 60" Mt. Wilson telescope, which is no small instrument, as will be appreciated by all those who have had the pleasure of looking through it.

A NUMBER of years ago a German astronomer, Dr. B. Schmidt, supplied another solution for the problem of building a fast, wide-field photographic telescope. The optical system of this camera is interesting because of the simple manner in which Dr. Schmidt solved a complex problem. For a long time it had been known that a spherical surface would not produce coma, provided the incident light passed through the center of curvature. Dr. Schmidt conceived the idea of placing a thin lens at the center of curvature of a spherical mirror, and giving this lens just enough curve to correct spherical aberration. As the combination should be free from both coma and spherical aberration, definition should be good over a wide area. When pictures made with the first Schmidt camera reached this country, they were so good that experiments were soon started on the making of similar cameras.

In spite of the fact that only meager information was available, it was possible to work out the design of such a camera, and theory indicated that it could be made as short as $F/1$, and should give good star images over a field of from ten to twenty degrees.

However, the actual construction of a Schmidt camera presented some difficulty. If made as short as $F/1$, the usual optical methods of testing the curvature could not be used. New methods had to be devised. Any one of a number of different curves could be used for the correcting lens, but the curve which would produce the least chromatic aberration was a double curve, convex at the center and concave near the edge. Such a curve could not be ground and polished with tools of the usual type. Tools backed with sponge rubber, to provide flexibility, were tried. Contrary to the predictions of some optical workers, the rubber tools worked. The field of best focus of the Schmidt is curved, so glass plates cannot be used, but film can be sprung to the necessary curve by a ring which presses the film against a convex disk. After the exposure, when the film is removed from the holder, it springs flat again.

When one compares a Schmidt camera with a camera using a fine anastigmat lens made up of four or more individual lenses, it is surprising to find that so simple an optical system can produce such good results. And, best of all, the Schmidt can be built in large sizes. The largest in use at present is an 18" $F/2$ on Mt. Palomar. Built as a scouting telescope for the 200", this camera has already proven its value by the discovery of two super-novae. But, as usual, astronomers were not satisfied. The 18" was so good that they now want another, bigger and better. Work has already been started on another dome which will house a 48" Schmidt, and a 72" Pyrex disk has been ordered for the mirror. The mirror of a Schmidt is larger than the lens, in order to catch the rays from stars near the edge of the field.

EXPERIENCE with fast cameras of this type has shown that for some types of work they are practically ideal, yet

for some other purposes they are not as effective as slower cameras. For example, a number of years ago a photograph of the constellation of Orion was made with a lens a little over an inch in diameter. The exposure was ten hours, in order to record the faint nebulosity which exists all through this constellation. The result is a beautiful photograph, which, at the center, shows stars of the 17th magnitude. A recent photograph of the same region, made with an 8" F/1 Schmidt, with an exposure of ten minutes, shows the faint nebulosity just about as well as the ten-hour exposure made with the slower camera. But the ten-minute exposure only reached stars of the 13th magnitude.

Naturally, one's first thought is, increase the exposure until the Schmidt also reaches the 17th magnitude stars. Unfortunately, this cannot be done, as ten minutes is the limit that we can expose with an F/1, using fast film. The limiting factor is sky-fog. That is, a general darkening of the film caused by the diffuse light of the night sky. Even out in the mountains, away from all city lights, the night sky is not black. It is really surprisingly luminous. Part of this luminosity is due to faint stars and nebulae, part may be due to light reflected from meteoric matter in space, such as is believed to produce the Gegenschein and Zodiacal light, but a considerable amount originates in our own atmosphere. There seems to be a sort of permanent Aurora which is always present, even when no Aurora can be seen with the eye. If exposures are continued too long, sky-fog blots out the images of the faint stars.

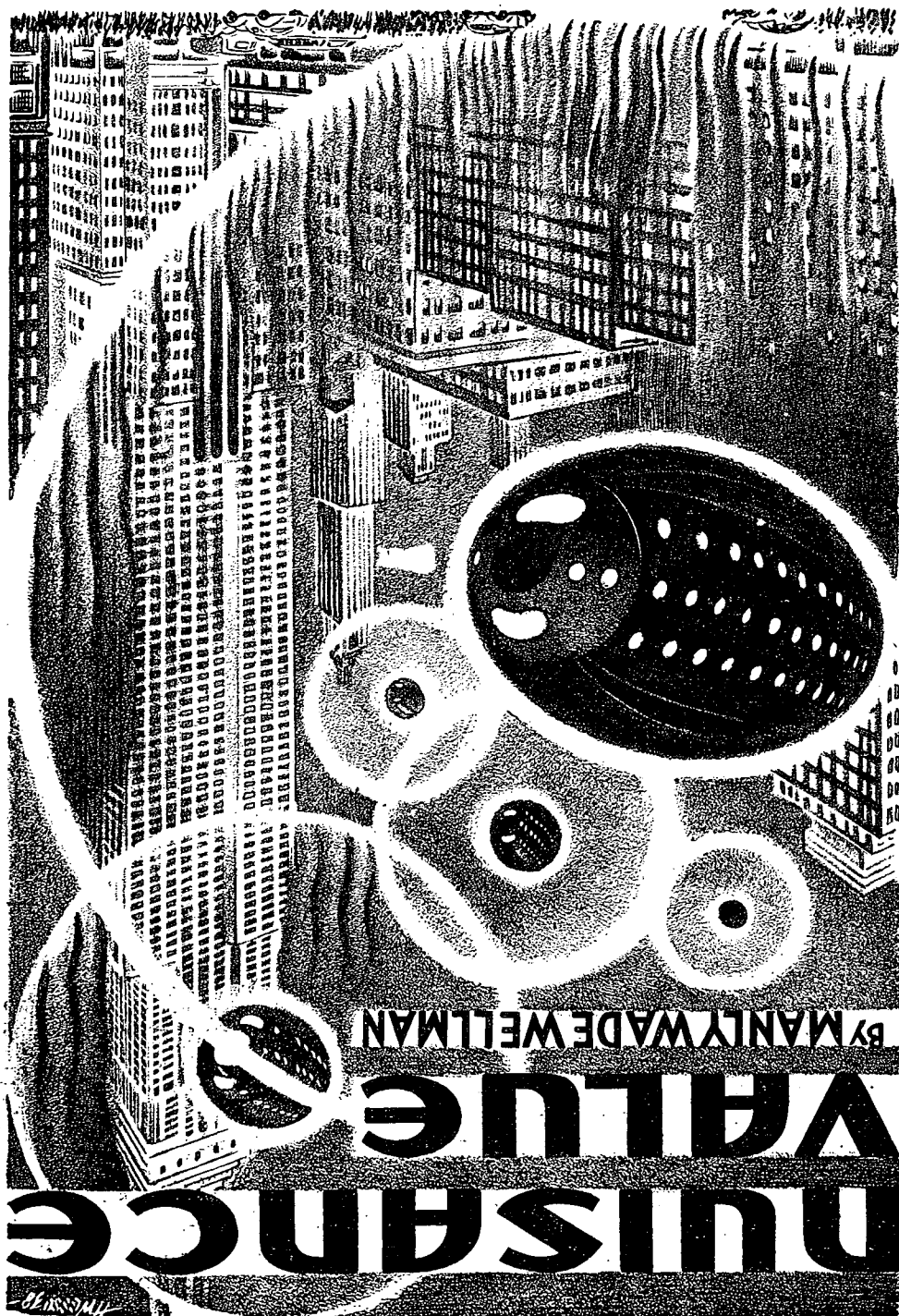
When photographing a luminous area such as a nebula or a comet, the exposure required is inversely proportional to the square of the F number; the shorter the focal ratio, the faster the camera. But this does not hold true if the object photographed is a star. The image of a star is a point, and the bright-

ness of the image depends, not on the focal ratio, but on the size of the lens; the bigger the lens, the quicker it can photograph a star. With a fast camera, nebulae will appear brighter in comparison to nearby stars than they will if photographed with a slow camera. The general luminosity of the sky also appears brighter to the fast camera, so sky-fog develops sooner, and limits the exposure. Increasing the speed of the film acts the same way—we just reach the sky-fog limit sooner.

The result is the rather surprising conclusion that a slow camera can photograph fainter stars than a fast one. The fast camera can reach fainter nebulae than the slow one. If we increase the size without changing the focal ratio, we can reach fainter stars, and also fainter nebulae. Evidently, if we want to reach the fainter stars, we need either bigger or slower cameras.

WHEN WE remember the astronomer who felt that a 26" telescope "had fully reached the limit of optical power", it is evident that one would be rash indeed who would try to predict the developments of the future.

Perhaps the telescope of the future will make use of some development of the Zworykin electron lens, or perhaps it will be some form of television which will solve that problem. Possibly there will be some entirely new discovery which will affect the design of astronomical instruments to an even greater extent than the discovery of photography influenced our present instruments. But whatever instrument the astronomer uses in the future, it will be built on the foundation which has been laid in the past, and even though his vision reaches to the outermost limits of space, he will remember the words of Newton—"If I have been able to see farther than other men, it is because I have stood upon the shoulders of the giants."



NUISANCE VALUE

Concluding Manly Wade Wellman's novel of a time when Invaders had reduced Mankind to no more than a nuisance. But as a nuisance, Man ranked supreme!

Synopsis:

Whence the Invaders came, no one ever learned. Their ships dropped down out of space one winter, landing all over northern Europe, North America and Asia. They seemed to have but two weapons—but those two were enough. The palely-white ray, and a screen of green-glowing force of some nature that stopped every weapon Man tried. Only one thing drove them back for a bit; a spell of thawing weather came, melting the ice and snow, and weakening the Invaders. Then the Invaders sallied forth again from their ships, each protected within an armor of refrigeration. They were huge, helmet-shaped, sluglike things—snails without shells—and they were cold. They came to be known as the Cold Creatures—and within fifty years they had all of Earth they wanted; the cold parts.

Men, licked to a standstill by their one offensive weapon, the white ray of explosion, helpless against their green sheath of force, crawled into the tropics. Earth's natural warmth defended him there, for the Cold Creatures didn't like it. They didn't trouble to pursue him.

But gradually, as they consolidated their holdings in the north, the Cold Creatures were moving toward the tropics, setting up advance bases. And a generation of men who hadn't fought the Invaders was growing up, men who hadn't been licked, and didn't know what it meant. Jungle chiefs of tribes and groups that had hidden away for a generation and more were mobilizing for a new war. They had airplanes, guns and cannon and bombs again, for men had brought their science and laboratories

and schools into hiding with them.

The chiefs were hot-headed; they wanted to attack the intrenched Cold Creatures. But Darragh, a young guide and scout, pointed out the hopelessness of it. True, they had guns and bombs and planes. But the whole world had had guns and bombs and planes and had been whipped into hiding! Did they want to repeat on a smaller scale the fiasco of the first defense? Bring down on their last refuge the ships of the Cold Creatures? They had no defense against the white explosion ray, nor any means to penetrate the green shield.

The chiefs still wanted to try. But Darragh won a concession of some slight degree: he was to go out, to spy out, somehow, the secrets of the cities of the Cold People. The chiefs would wait six months for him, and then, if he hadn't returned, attack.

Darragh reached an island outpost of the Cold People in the Caribbean, and there was captured and taken to a great city on Lake Michigan. On the way, he killed his two captors, gained control of the ship, only to be recaptured; ship and all, and forced into the city. Driven and harried through the corridors of the immense, dome-protected cold city, he at last tumbles through a doorway into a domed village within the domed city—to be met by a human girl!

VII.

DARRAGH sat up then, and gazed around. He saw that the people were clad neatly, in the fashions that had prevailed in the days of his unconquered grandfathers—the men in jackets and trousers, the women

in dresses of print or stout weave. There were about thirty of them. The particular blond girl who was helping him seemed capable and pretty, and she wore a dark skirt, a white blouse with short sleeves, canvas slippers and no stockings. Her bare arms and legs were tanned to a shade darker than her golden curls.

Just beyond the gathering was a town, or at least it looked like the towns Darragh had seen in old salvaged pictures. There were about a dozen cottages, of planks and snug red tile, with lawns and flower beds, ranged around a wide central court. Behind and around them rose a great lead-colored wall that extended in a curve to meet behind Darragh as he faced the men and women. A sort of immense chimney at the bottom of which the town nestled. High above, the shaft was filled with radiance, dazzling and warm, that touched everything with brightness.

"Where did you come from?" the blond girl was asking.

He told, as quickly as possible, and those who listened sometimes gasped and sometimes put quick, stammering questions. The only calm person was a youngish man with canny eyes set close together. When Darragh had finished, this calm man drew a deep sigh.

"I had no idea," he said, "that there were still free human beings."

"Not free?" asked Darragh. "What do you mean? You seem free enough."

"But we aren't," the other assured him.

"Is this a prison?" Darragh asked. "Why don't we fight our way out?" He got to his feet, but staggered weakly.

"I am afraid that you aren't exactly ready to fight your way out," said the man with the close-set eyes. His voice had a note of calculation, that suggested scorn. "Perhaps you'd be better advised to wait awhile. We've been content to wait, so far."

"That's right," spoke up an older man

in the group. "Our time's coming." His manner was dutiful rather than confident.

"I don't intend to wait," announced Darragh firmly. He was still shaky on his legs, and the blond girl supported him with a hand under his elbow. He seemed to get a trifle of new strength from her steady touch.

"You need rest," she was saying, very businesslike and kind, as she eyed him gravely. "Perhaps a bite to eat." She addressed the man with the close-set eyes. "Take his other arm, Jib. We'll get him to my place."

The man called Jib did so, and, gaining strength as he walked between the two, Darragh let himself be guided to one of the cottages. The other people followed, with an air of restrained curiosity, but at a word from the man who assisted Darragh they paused just outside in the court.

The cottage interior seemed tasteful and comfortable, with rugs, furniture, pictures on the wall, a shelf of books. In the center of the room rose a four-by-four joist or support, as though the roof were too heavy.

THE GIRL excused herself and went into another room. The two men faced each other. Darragh found the close-set eyes to be probing him.

"I'm Jib Orrin," he heard the calculating voice say, "and I'm pretty much in command here. Darragh, do you mind if I say you're not acting consistently?"

"Why not?" demanded Darragh, loosening his leather armor and beginning to draw it from his shoulders.

"It seems, from what you say, that you urged a policy of waiting when you talked to those chiefs of yours in the tropics. Yet now you want to start off half cocked."

Darragh considered. "How long do you expect to wait?"

The other's eyes grew narrow in

thought. "Perhaps for years," replied Jib Orrin. "Perhaps for generations. We have an approved plan of escape that calls for knowledge, study—"

"Hold on," interrupted Darragh warmly. "I can't wait so long; I have to get back and report in six months."

Orrin smiled wispily. "And how will you escape?"

"I'm not quite sure yet," Darragh was forced to admit, and he felt his ire waken as Orrin's smile grew wider. "Yet," he continued, "it should be possible. There are about thirty people here, and if—"

"These people obey *me*, Darragh," Orrin reminded him, quietly but bluntly. "They know what we plan, and are working with me. We will take plenty of time, and when we move, it will be an assured success."

Darragh, struggling the rest of the way out of his leather suit, glanced out of a front window. "They seem mighty interested in what's going on in here," he remarked. "Look how they've stayed in a group outside. They're whispering together. Why don't you let me tell them about what I would like to do?"

"I shall explain," said Orrin, with something of condescending superiority. "We are scientists here. Our fathers, first captured almost at the moment of the original invasion, have passed on valuable knowledge. We have picked up other valuable bits of science from our captors, the Cold People. Some of their principles—the rays and so on—we understand. We shall learn to produce those things some day. We shall learn, slowly and not in a way to cause suspicion, how to build and operate one of their ships. In that ship we shall fly out of this prison shaft, and away to freedom."

Darragh sighed. "I can see how that will take years, all right," he nodded. "Sorry I can't hang around and watch it work out."

"What else can you do?"

"I'm forming a plan while we talk here," Darragh informed him. "I want to offer it to your crowd here, to take or leave."

Orrin's eyes grew bright and hard. "And if I forbid you?"

Darragh straightened, and his anger began to get the better of him. "Go on and forbid me," he snapped. "I'm not under your orders, and I'll say what I please—when and to whom I please."

"Here, here," cried the girl. She had come back, with a tray in her hands. "Are you two fighting?"

Orrin's close-set gaze shifted to her. "I'm afraid, Brenda, that this is a dangerous man," he said. "He wants to break up our plan of escape."

"Nothing of the kind," protested Darragh. "I'm simply offering suggestions—"

"Keep them until they're asked for," Orrin cut him off.

Darragh fought to remain cool. Again he glanced out of the window, and something about the earnest, murmuring group there pleased him.

"I wonder," he said, "if my suggestions aren't being asked for already." Once more he faced Orrin. "You've jumped to the conclusion that I'm going to steal your thunder. You think I'm a rival. I didn't mean to be anything of the sort, but I don't let challenges lie."

Orrin smiled again, and put his hands into his pockets. He turned toward the door.

"Wait, Jib," pleaded the girl. "I've brought some tea."

"No, thanks," said Orrin. "I'm going to confer with . . . a colleague of mine. And I'll be back, Darragh. There's another rebuttal to your argument that I hope to offer."

He stalked out of the cottage.

"TOO BAD you made him angry," said the girl. "He can't stand to be

opposed. Here, I've brought you a light robe." She set down the tray and took the robe from her arm. Darragh thanked her and drew it on, and then he saw something that made him start.

At the rear of the room was a window of glass, and a Cold Creature was pressing interestedly against it, as if watching. The girl noticed Darragh's sudden motion, and laughed at once to reassure him.

"They often watch us," she said. "They never do harm."

"I don't want to be watched," he replied at once. "Let's go into another room, Miss—"

"Thompson. Brenda Thompson. There's only one other room, and they can look into that. Into every room of all these houses, and into the grounds."

"It's like a zoo," Darragh growled, and she nodded her head.

"That's what it is," said Brenda Thompson. "A zoo. We're kept here alive, allowed food and other materials for our support. And they study us."

"But to pry into this cottage—isn't it yours?"

She shook her head. "I'm afraid not. It's only a show piece, like the imitation rock den in a bear pit. The walls are flimsy, for we have no winds, no storms. Only the roof need be strong, because snow and rain do come from above. See this central post? That's to prop up my roof tiles. They're pretty substantial, and not the sort of thing you'd want on your head. Sit down, and I'll tell you what else I know."

They drew up chairs close to the supporting timber. Brenda Thompson poured tea, something almost forgotten in Darragh's jungle homeland. He was awkward with his cup, the more so because of what he was hearing.

"I shall begin at the beginning," said the girl. "At least, I shall begin with what I have heard of the beginning. The Cold People—you call them that, too,

eh?—came on Earth like a thief in the night."

"I know about their coming," Darragh told her quickly. "How did you—your people, that is—live through it?"

"We were situated in a tiny town, a sort of scientific retreat, on the shores of the lake. You see, we were professors then, teachers at the State university at Ann Arbor."

"I think I see, Miss Thompson. You were all scientists and teachers, probably too deep in study to appreciate the danger."

She nodded. "A failing, that, of scientists and teachers. First thing they knew, it was too late. The Cold People, obliterating armies and cities all around the colony, had hemmed us in." She paused. "I mean, of course, my grandfather and his associates were hemmed in. Nobody alive today saw that happen."

"There was, naturally, nothing but surrender."

Darragh looked at her sharply. "How was that managed? A white flag?"

"Nothing so elaborate. The leader, Dr. Orrin—Jib's grandfather—told everyone to stand quite still, with hands up. There were half a dozen professors, their wives and children. The Cold People came in their armor, with ray-guns leveled."

"I'm interested in those rays," interposed Darragh.

"I'll tell you what I know of them, later," Brenda Thompson promised him. "We have some communication and understanding with the Cold People. But, getting back to the history, that little knot of human beings was herded into some kind of pen. There was a conference of Cold People leaders, and then this prison—this zoo—had its beginning."

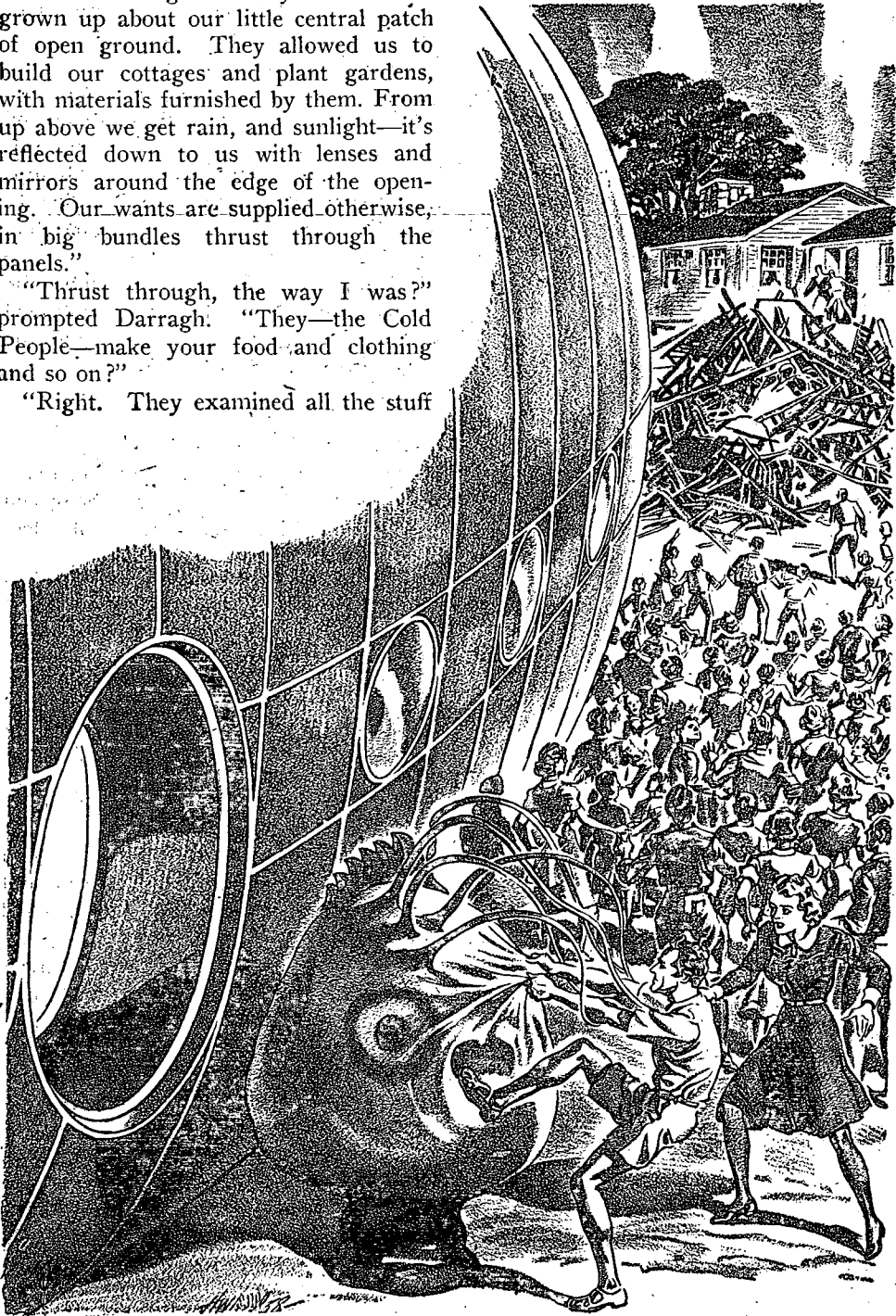
"And after that?"

"We've lived here ever since, a peep-show, for two generations," said Brenda Thompson, and she sounded grim about

it. "This refrigerated city of theirs has grown up about our little central patch of open ground. They allowed us to build our cottages and plant gardens, with materials furnished by them. From up above we get rain, and sunlight—it's reflected down to us with lenses and mirrors around the edge of the opening. Our wants are supplied otherwise, in big bundles thrust through the panels."

"Thrust through, the way I was?" prompted Darragh. "They—the Cold People—make your food and clothing and so on?"

"Right. They examined all the stuff



captured from human beings. They supply us as keepers used to supply captive monkeys or rabbits. Of course the food is frozen, but that way it keeps longer. There is meatlike stuff, and bread, and tea—all of it synthetic. They're masters at making chemical foods and fabrics. We grow green things enough in our gardens for vitamins.

"And we live in a zoo," finished Brenda Thompson. "About thirty of us, the children and grandchildren of these professors who surrendered. A zoo or aquarium for Cold People to stare at. They can stare, though they have no eyes." She lifted the pot. "More tea?"

DARRAGH held out his cup. "Thanks. How about government, Miss Thompson? Even ants in a hill have that."

"You've met Jib Orrin. He had inherited what command there is among us. Not much to do, except communicate with the Cold People. He makes signs with his hands to those that watch through the glass windows. They understand. That way he gets us things we need, extra food or even medicine. And we never knew, until you showed up today, that there were free men outside."

A new point perplexed Darragh. "Why didn't they just kill me outside? The Cold Creatures in the ship tried hard enough."

"They must have thought you were one of us, somehow escaped," surmised Brenda Thompson. "They herded you here, and pushed you inside—the logical thing to do."

Darragh was feeling better and more confident. "The more fools they," he said. "I came here to find a way to overthrow them. What better place to start than here? And what about Jib Orrin? Is he brave? Wise? Is he learning things from the Cold People?"

"Some . . . but he doesn't talk

about it," she made answer. "Not even to me, and I know him better than most."

"You and he are friends?"

"He wants to marry me," she explained, as though she did not relish the idea. Darragh found that he did not relish the idea, either. Brenda Thompson seemed too pretty and sensible to waste on a cold, proud individual like Jib Orrin.

"He and I will talk again later," he promised. "Meanwhile, we mentioned those ray-weapons. Will you tell me what you know about them?"

VIII.

"I'LL DO my best. The two rays—the white explosive one and the green power one—are both forms of electricity. Maybe you guessed that."

"Electricity? But I didn't tingle when they rayed me with the green," Darragh ventured.

"No, because you weren't vibrated. You see, that ray controls all bodies it involves, from dust particles up to . . . well, up to the heavy roof of this shelter dome."

"A ray holds this roof!" cried Darragh.

"It's true. Do you think they could find the material, in that quantity and strength, to build so quickly a solid structure two miles high? Try it yourself some time, Darragh. The lower curves of this dome are supported, as I understand, by concrete and metal supports. But in this region, at the very center where the curve rises highest, the great weight is supported by a special formation of rays, pointing upward. They act as girders, shining up from a ring of generators around this little shaft where our cottages are confined."

"I saw something else just outside your walls," Darragh remembered. "Water that didn't freeze, though the temperature must have been subarctic."

"We'll come to that later. I want to finish about the green ray. It controls, I say, all bodies that it involves or encounters. By manipulating its various powers, an operator can push those bodies away, hold them locked in space, or drag them down to the source of the light. You've apparently had experience of all three powers. It can even go-around a corner, I think, though I've never seen that managed. A mirror arrangement of some kind might reflect it at an angle."

"I can understand that," said Darragh. "Can't the ray be blocked off, though? Some screen pushed across it, to darken it—let the roof of the dome fall in, for instance?"

Brenda Thompson smiled. "I see. You'd like to wreck this stronghold. I'm sorry, but nobody is able to cut across that ray's path once the power is on. During the early days of fighting, the Cold People made curtains of it and bounced back bullets and shells. You must have heard of such things."

"Yet something might throw the source or the reflector out of order," persisted Darragh. "A bomb, for instance—"

"Yes, a bomb of considerable explosive force, set off in the middle of our court, might smash the walls of the shaft and jam all the fixtures. However, there are no such bombs to be had. Let me finish; the green rays are used in all delicate mechanics—in governing the flight of their ships, in running the motors, in serving for levers, pressures and props, and in their chemical synthesis of food."

"How do they make their food?"

"The ordinary elements—carbon, nitrogen, hydrogen, oxygen. But the active principle that brings the job off properly seems to be distilled from a vegetable they brought from their home planet. It can grow only in bitter cold, of course. Jib Orrin, the only one of us who can understand the Cold People and make

himself understood by them, says that they grow crops of it in the polar regions."

Darragh rose, walked around the timber support, and set his cup on a table. He found a bit of paper and a pencil-like rod of lead. "Mind if I take notes?"

"Go ahead. Now, about the explosive ray—"

"Yes," he interrupted eagerly, "how do they manage that thing? It must be terrifically hot, beyond anything they can stand."

"Apparently the Cold People can exist only in subzero temperatures." Brenda Thompson told him. "Jib's father and grandfather made studies, and say that the comfort point of the things is about 60° below zero—comparable, perhaps, to 70° above for us. Zero would be the utmost endurable summer heat to them, and a hundred below would be only a bracing tingle of frost. According to those temperature calculations, they probably come from the planet Jupiter, or one of Jupiter's moons; where it's unthinkable cold."

"But this doesn't make the explosive ray impossible to them," she informed Darragh. "You see—it isn't really hot at all. It doesn't effect explosion by heat. It's cold in fact."

"Not heat! Then how else?" demanded Darragh.

"By changing the type of water in whatever it encounters. By changing ordinary water into H₂O."

"But H₂O is water," Darragh almost barked. "What kind of a riddle—"

BRENDA THOMPSON was shaking her head and smiling. "Let me give a little lesson in elementary science, Darragh." She rose, crossed the room, and from the bookshelf selected a faded brown volume. "This," she explained, "is the *Handbook of Chemistry and Physics*, compiled in the earlier part of the twentieth century by Hodgman and

Lange for use as a reference book by students and experimenters. It tells, among other basic facts in science, that normal water is H_2O merely in proportion. A normal water molecule isn't made up simply of two hydrogen atoms and one oxygen atom—rather of sixteen hydrogen atoms and eight oxygens. It's shaped not like a shamrock, but like a raspberry."

"I understand that," said Darragh once again, "and the book undoubtedly knows what it's talking about. Well, you say that this ray somehow rearranges the atoms—breaks up the complex molecules into smaller, simpler ones. Yet proportions are the same. What's the big difference?"

"A far lower boiling point," Brenda Thompson replied. "Human science isn't sure, but we can work it out pretty well by consideration of other known facts." She studied the book for a moment. "Set down these figures," she directed. "At the top of the column, put normal water— H_2O , with boiling point $100^\circ C$."

"Boiling point, 100," echoed Darragh, writing.

"Now for another hydrogen-containing liquid, hydrogen telluride. Boiling point, zero degrees, Centigrade."

" H_2Te ," Darragh spelled out. "Boiling point, zero."

"Next in the column, hydrogen selenide—minus 42."

" H_2Se boils at minus 42."

"And hydrogen sulphide," continued the girl, her forefinger traveling down the page. "Boiling point, minus 60. Now, what have you got?"

Darragh showed her his column of figures:

H_2O	boils at 100 degrees
H_2Te	 " " 0 "
H_2Se	 " " -42 "
H_2S	 " " -60 "

"If we're right, we can progress to hypothetical H_2O ," pronounced Brenda

AST—8

Thompson. "We'll work it out by comparing weights of atoms in relation to each other."

Taking the paper, she scribbled a table of atomic weights:

Tellurium weighs	127.5
Selenium	" 79.2
Sulphur	" 32.06

"And one more," she said:

Oxygen weighs	16.00
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"In other words," Darragh saw quickly, "the boiling point varies inversely with the atomic weight."

"Yes, in a general sort of way... It helps us to figure, somewhat roughly, the boiling point of true H_2O —simple water. It will be around minus 100."

"Whew!" whistled Darragh. "That would be minus 212 degrees Fahrenheit—colder than liquid air!"

But Brenda Thompson again smiled dissent and shook her curly blond head. "Not quite. You forget zero Centigrade equals plus 32 Fahrenheit. So the boiling point is about 148 degrees below zero, in Fahrenheit figures."

"Quite cold enough," said Darragh, and shivered involuntarily. "The water just outside the entrance to this prison must be that stuff."

"It is. Always boiling, even in the freezing temperatures that Cold People maintain, but supplied by ray action on ice and frost. There wouldn't be any escape that way, you understand."

"As to the explosive ray," went on Darragh, "it works by breaking normal water down into this stuff that boils at such a low temperature. Naturally, that low-boiling compound would turn at once into steam—and explode. A living body, a tree or animal or other object with lots of water in it—"

"Would fly into a cloud of particles," finished Brenda Thompson for him.

"That's what happened to most of the human race fifty years ago."

DARRAGH rose to his feet. He threw off the robe and thrust his notes into the pouch at his girdle.

"Thanks for the lecture, Miss Thompson," he smiled. "I'm getting out of here somehow, and I'll pass this information on to my chiefs. They'll be interested."

"I'm sorry, Darragh," came Jib Orrin's voice from the door. "I doubt if you'll ever see your chiefs again."

The master of the captive community had entered, hands in his pockets. His cold face reflected triumph.

"We'll not have the benefit of Mr. Darragh's company much longer, Brenda," he said.

The girl's eyes widened. "What have you done?" she asked quickly.

"The only logical thing," replied Jib Orrin. He turned upon Jib Orrin. "I have already described you and your disturbing ideas of a quick, desperate break as dangerous. You refused to be advised by me, and said that you'd try to influence this community to follow your line of reasoning."

"I meant it," said Darragh.

"I was sure that you did. And so, while you've been taking tea here, I was at a window in my own quarters. I passed on some information to several of the Cold People. They know that you're a spy and an enemy, Darragh. They're bringing a ship down from above, and they're going to take you away in it."

IX.

DARRAGH took a long, quick step forward. The muscles on his shoulders bunched and grew tense. Jib Orrin did not retreat nor make a motion to defend himself.

"Now you're going to try violence," he mocked coldly. "Come on and hit me. I'm chief here, and my people out-

side will tear you to pieces."

Darragh did not strike. At Orrin's threat, he relaxed and gazed. His face showed not fear, but the dawning of inspiration.

"Jib," Brenda Thompson was saying, her voice trembling, "this is cruel and cowardly."

"It is practical," he replied, without heat. "A man has blundered in from outside, a savage who, by luck and audacity, has survived where a sane and cautious individual might have died many times. He announces that he will overthrow a plan that has, in its formation, consumed years of my life, of the lives of our fathers. He must be eliminated."

"But stop and think," pleaded the girl. "Aren't you losing sight of the fact that there might be another way than yours, Jib? Perhaps even a better way—"

"Never mind, Brenda," interposed Darragh quickly. "Orrin, I must disagree with you once again. You said your people would tear me to pieces at your word. That's a lie, and you know it."

Orrin's face did not change expression, save for a sudden brief wavering of the eyes.

"If you trusted your people," went on Darragh, "why didn't you set them on me instead of selling out to the Cold People?" He did not wait for an answer, but brushed past his betrayer and stepped out upon the porch. In the court stood the men and women of the captive settlement, and they gazed at him with a sort of expectancy.

He raised his voice: "Ladies and gentlemen, fellow human beings held prisoners, come close and listen!"

They did so at once, crowding into the lawn-space in front of Brenda Thompson's cottage. Darragh went on: "You know by now that I came from outside, where thousands of free men are planning to overthrow these frozen monsters

that took our world away from us. Anybody want to join us?"

There was an excited stir, and a woman's voice asked: "How can we?"

"I'll manage it," cried Darragh, with a confidence he really felt. "I got in here, and I can get out again. And I can get out *now*—not in fifty years! All who want to come along, step forward from the bunch."

Again the stir, becoming an eddy. A vigorous, grizzle-haired man pushed into the open. "I'm with you, fellow! I've been a peep-show long enough!" he cried.

"Me, too," and a woman, perhaps the wife of the grizzled man, also emerged from the group. More cries, and fully half a dozen moved as though to offer themselves as rebels against the Cold People. They put up a sort of cheer, in the midst of which both Orrin and Brenda Thompson came out on the porch.

"Wait," said Orrin. His voice, without seeming to lift, yet made itself heard afar. "I must ask you all, my friends and followers, to be sensible. This stranger, half an hour old in our midst, tries to sweep you into a suicidal attempt at escape. As a matter of fact, he is a spy and an enemy."

Darragh wheeled upon his attacker, but it was Brenda Thompson who answered the charge. "Orrin is right," she called out clearly. "Darragh is a spy—on the Cold People! An enemy—to our enemies! And Jib Orrin has just informed on him . . . given him up to the things that hold us captive!"

"Is that the truth?" demanded the grizzled man, boldly and quickly, of Orrin. One or two others grumbled suspiciously. But Orrin had ruled for years, and he did not recoil from the hint of menace, nor did his studied scientific calm desert him.

"You all know," he said, "that our dearest hope is some day to win free of this cage. You all know that we will

have a chance when the time is ripe, and that we must succeed then or never. You all know, too, that I, building upon the labors of my father and his colleagues, have been gathering information toward the building of an airship for our flight. I have never withheld these facts from you." He paused and saw that he had the respectful attention of his people.

"I have betrayed this stranger," he went on with cool frankness, "for a two-fold advantage. First, his ill-planned escape attempt would fail and we would be doubly guarded and fenced in, doubly far off from liberty. Second, by informing on him, I convince the Cold People that we are mild, content. They will remove him, and trust us as never before. Is this not sufficient explanation?"

HE THOUGHT that it was, and made a gesture of dismissal. The gathering settled almost on the point of breaking up. But once more Darragh made appeal.

"Hold on, every one of you," he urged. "Let me say a last word!"

Quick as thought, his long arm shot out, his hand closed on the shoulder of Jib Orrin. The smaller man tried to jerk loose, but a vigorous shake subdued him for the moment. The onlookers paused even as they moved to disperse. Every man and woman came to amazed, shocked attention.

Darragh knew that he would have brief seconds of that attention he had so violently and melodramatically claimed. He shook Orrin again, for emphasis. "Let me tell you something about this sneak!" he trumpeted. "He communicates with your jailers, and he snitches; he can, and will, snitch on any of you who does not suit his royal high mightiness!"

"I . . . I was acting for the best," spluttered Orrin. His calm, serenity, and disdain had flown. He struggled futilely in Darragh's grasp. "Unless we have time and knowledge to build a ship,

learn to fly it—"

"No need!" Darragh cried. "Our ship's going to be here before we know it. I mean the ship that's coming for me—but *we'll capture it as it lands!* I can fly those machines, and I'm going to get you all out of here, this very hour!"

His audacious bid for approval was succeeding. The grizzled man and one or two others shouted enthusiastically; and still others took up the cry. Darragh clinched matters by thrusting Orrin down from the porch.

"Grab this traitor, some of you," he directed, and two of the biggest men obeyed, almost automatically. "Now, then, we've got a trap to set."

Brenda had come to his elbow. "This is all pretty overpowering, Darragh. How will you do it?"

"How will I do it?" he echoed, for all to hear. "Those Cold People won't be expecting trouble—except from me. They'll come to this cottage, won't they?" He addressed his new allies again. "Have you some ropes? Bring me the strongest, longest ropes you have."

Turning, he rushed into the cottage. A glance showed that no Cold Creature was idling in sight. He snatched up his leather coverall from the floor.

"Bring me something to stuff it with," he said to Brenda Thompson. "Bed-clothes will do."

"What for?" she demanded, then hurried to obey without waiting for an answer. She brought back a pillow and some sheets, with which he quickly padded the empty suit in the semblance of a human body. Then he drew it upright against the central joist that supported the roof. With a napkin he tied it there, then drew its arms aloft against the timbers and spiked them in place with his sheath knife. With its hood propped up to simulate a head, the stuffed garment was amazingly lifelike.

"There I am, in surrender pose," he

panted. "Can it be seen from the open door?" He dropped back and squinted. "Yes. Now, what about the ropes?"

He strode back upon the porch. A dozen men were approaching, holding out coils of line. He chose the two strongest pieces and doubled them for extra strength.

"Is there a window at the side of this cottage?" he asked Brenda. "Is there? Good. Pass one rope through the window, you men, I'll take it on the inside."

When it was done, he knotted his end securely at the bottom of the supporting joist.

"Now the other cord, through the window opposite." He stood on tiptoe to draw it close around the top of the timber. "Draw them tight. Careful—not too tight. That will do. We're ready."

Outside, he split the body of villagers, men and women, in two. To each party he assigned the free outer length of a rope.

"Be nonchalant," he said earnestly. "Stand at right and left of the cottage, as if you were curious or interested. The ship will land, and several Cold Creatures will come into Brenda's parlor after me—or after my suit, which looks pretty much like me just now. When they're well in, I'll signal you. Drag on those ropes. One of them will jerk the top of the timber left, the other will pull the bottom of it right. And down will come the tiles, around their ears."

"I get you, boss," said the grizzled man for them all. "And after that?"

"As soon as the roof goes in, dash around to the front, all of you. There will be one or two guards outside, or I miss my guess. We'll have to tackle and kill them. After that—away we go."

ONCE MORE the group cheered him, and in the midst of the cheer a shadow fell across the court, a shadow that grew and darkened. The ship was

coming down from above, and it was a big one. The villagers, born and bred in captivity, cowered instinctively.

"Chins up!" rasped Darragh. "Take your places. You two big fellows, keep Orrin back behind the others, out of mischief. Brenda, come with me. We'll watch from the house opposite."

There was a scramble for the appointed positions. Darragh and Brenda hurried across the court and, when the ship settled down, they were peering cautiously from the parlor. The vessel was at least fifty feet long.

"It'll hold everybody," commented Darragh. He sounded content, as though the ship were already seized.

"I may be a fool," replied Brenda's soft voice from behind him, "but I think we're going to win."

A hatchway swung open. The Cold Creatures were shuffling out, six of them. All were in armor, and all bore ray-weapons at the ready in their tentacles. Facing toward the cottage of Brenda Thompson, they quite evidently saw the form of Darragh's leather decoy inside, its arms aloft in token of surrender.

One of the things paused, standing guard beside the open hatch panel. The other five, formed into a watchful squad, moved confidently toward Brenda's cottage. They took scant notice of the idle-seeming groups of human prisoners to left and right of the little building. At the very doorstep, a second member of the party dropped back, as though to stand guard at the entry. The other four humped themselves up on the porch, moved in a body into the parlor.

As they passed the threshold, there was a cry and a flurry among the people grouped at one side. Jib Orrin had broken away somehow, was racing into view, swiftly gesticulating. Perhaps he meant to warn these allies he had summoned.

"Now!" roared Darragh from his post, in a voice like a bugle, and himself

rushed forth and at the guard by the ship.

A dozen leaping strides carried him across the intervening space. From behind he struck, and swiftly. Before the thing was aware of his attack, Darragh had clutched its ray gun and was striving to possess himself of it. In his ears rang a thundersome crash—the two groups, heaving on their ropes, had dislodged the joist inside, and the tiles had fallen in; the four Cold Creatures must have been squashed like chipmunks in a deadfall. He spared a single glance, in time to see the creature at the doorstep speeding a flash of cold white fire against the flying Orrin, who burst into a cloud of foul vapor. Then the rest of the men and women, dropping their ropes, had flowed from both sides and over the sentinel monster like vengeful waves.

After that, Darragh was too busy to watch or to listen. The thing he had grappled was too heavy, had too many tentacles. He could not bowl it over, could not disarm it. With desperate inspiration he let go his hold on the ray-weapon, clutched at the thing's armor. The fabric bunched flexibly in his two strong hands. Bracing a foot against the rubbery hulk, he dragged and ripped with all his strength. For a black half-instant he thought that he would not be strong enough, and then he was falling away, rolling awkwardly on the ground. The fabric of the armor had torn. His adversary, exposed to the deadly summer temperature, quivered and swelled—and subsided.

He got to his feet. Brenda, half cheering and half weeping, was at his side. "We've won!" she exulted.

AND THEY HAD. Through the ruins of the cottage swarmed the victorious captives, stamping and clubbing the bulks that feebly twitched under the weight of tiles and planks. The grizzled man was coming briskly toward Darragh. In his hands were ray-weap-

ons of the vanquished Cold Creatures.

"Good," said Darragh. "I want some samples of the armor, too. Anyone killed besides Orrin?"

"Three men."

"That's regrettable—but the rest of us had better get out of here." He lifted his voice. "Run to your homes, pick up tools, books, food. Hurry!"

Obediently they hurried. Reporting back with a heterogeneous lading, they ranged at Darragh's order in a double file. They marched into the ship, like children at a fire drill. It was not too crowded, thought Darragh as he and Brenda brought up the rear, entered and closed the hatch.

He found himself suddenly nervous. He, who had spoken so confidently of flying, had extended his confidence to these others so that they had risen and overthrown their jailers, now took time to remember that he had guided but one small ship—and that without ever landing or taking off. But all eyes were upon him, expectant, trustful; and the eyes of Brenda Thompson raptly admired. He stepped to the controls, drew high the bead on the upright arm.

There was a sharp hum, a swish. And they were far up into the blue sky. Rising perpendicularly as though drawn by a line, the craft had negotiated that chimneylike tube without mishap. Darragh carefully lowered the up-bead, flattened out the course, advanced the forward bead. A glance out of the port gave him his bearings, and he managed a sweeping turn to southward. Then he put on a brisk speed, for other ships were rising from panelways in the dome, as though to investigate him.

"We're making it," he said, as though to himself. With the back of his hand he mopped cold sweat from his brow. His grin of triumph widened, and he met Brenda's shining eyes. One of those shining eyes winked at him, a comradely wink.

"Yes," she agreed, "we're making it.

Where away, Commander?"

"South America, and the headquarters of the army of reconquest," he answered. Once again the people he had rescued gave a cheer. "Come over here, Brenda," he went on. "I want to teach you to run this thing."

"Anything you say, Darragh." She came close.

"Anything?" he repeated.

"Yes. You're boss of the bunch now."

"And of you?"

"Of me. Yes, of course."

They looked at each other sidewise, and rather shyly, but it seemed to serve. Darragh began to instruct her in flying the ship, and the plan of reconquest grew clearer in his mind.

X.

LOOKOUTS on the hills north of a certain jungle settlement, a market-village governed by Chief Megan, were horrified to see a sizable ship of the Cold People swooping overhead. They were more horrified still to see the craft settling gingerly down into a cleared space that did duty for a plaza among the tree-shaded houses. They came forward cautiously, and were only half-reassured when they saw men, apparently just emerged from the ship, haranguing the villagers.

"Leave your homes!" a tall, lean young man was saying authoritatively. "Get out into the jungle. The pursuit will catch up before long, and they may ray this place to atoms."

Megan, who had been eating his dinner, came rushing forth with his mouth full. "Oh," he grunted, "it's you, Darragh. Why did you come back so soon?"

"I captured this ship," Darragh informed him. "I rescued these people from captivity, and brought everything here. The Cold People—their patrol ships, anyway—have been hounding me, and they'll follow along pretty quick.

Let's clear out until they go away for good."

"You've brought them down to wreck our homes," accused Megan.

"Maybe—but next year year we'll be back in the countries they took from us," Darragh promised. "Don't argue now. Lead everybody to some safe place, where we can talk."

Megan agreed angrily. All hands cleared out to a remote lakeside, where they sat hidden by the trees. Whatever Megan thought, that was necessary. Darragh maneuvered his ship into a brief hop, setting it down in a gully where it could be quickly concealed under leafy branches torn from the forest, and then came through the underbrush with his own contingent. Megan was impressed by the scientific knowledge the freed captives had inherited from their professor-forbears, and he could not but admire Brenda Thompson's good looks. His good humor, too, was restored after he and Darragh had talked together for a full two hours. Not even the appearance for the Cold People and their briefing of the empty town could discourage him after that conference.

When the pursuit fleet had taken its departure, repairs were begun on the damaged homes, while short-range wireless and smoke signals were employed to gather the chiefs of allied communities. The formal council was held on the first Tuesday in October, attended by an even dozen leaders, Spence prominent in the foreground of the gathering. This time Darragh did most of the talking, with Brenda at his right elbow and Megan at his left.

His explanation of the ray weapons, the fortress plans and other baleful mysteries of the Cold People got eager attention and acceptance. But Spence, critical and a little apprehensive, asked the question that all hoped to hear answered.

"You promised to help us conquer these Cold People, young fellow. What's

your plan of attack?"

"We won't attack," replied Darragh. "Not in the way you mean, anyway."

"You don't think we can win by defensive action?" demanded the swarthy Capato, from where he sat with the other Indian chieftains.

"No," said Darragh. "I'll give my plan in a word:

"Nuisance!"

THEY GAPED and snickered. "Nuisance?" bellowed Spence. "What's this, a joke?"

"I'll give you a parable," offered Darragh, and all fell silent. "In old New Jersey," he began, "the Swedes once tried to settle. The Indians fought them—and got licked. The Dutch fought them—and were repulsed. The English fought them—and couldn't root them out.

"Yet the Swedes moved on."

"Why?" asked Capato.

"Because of the mosquitoes. A nuisance that didn't stand up and fight, but forced them away."

"I see," sneered Spence. "We're to be mosquitoes."

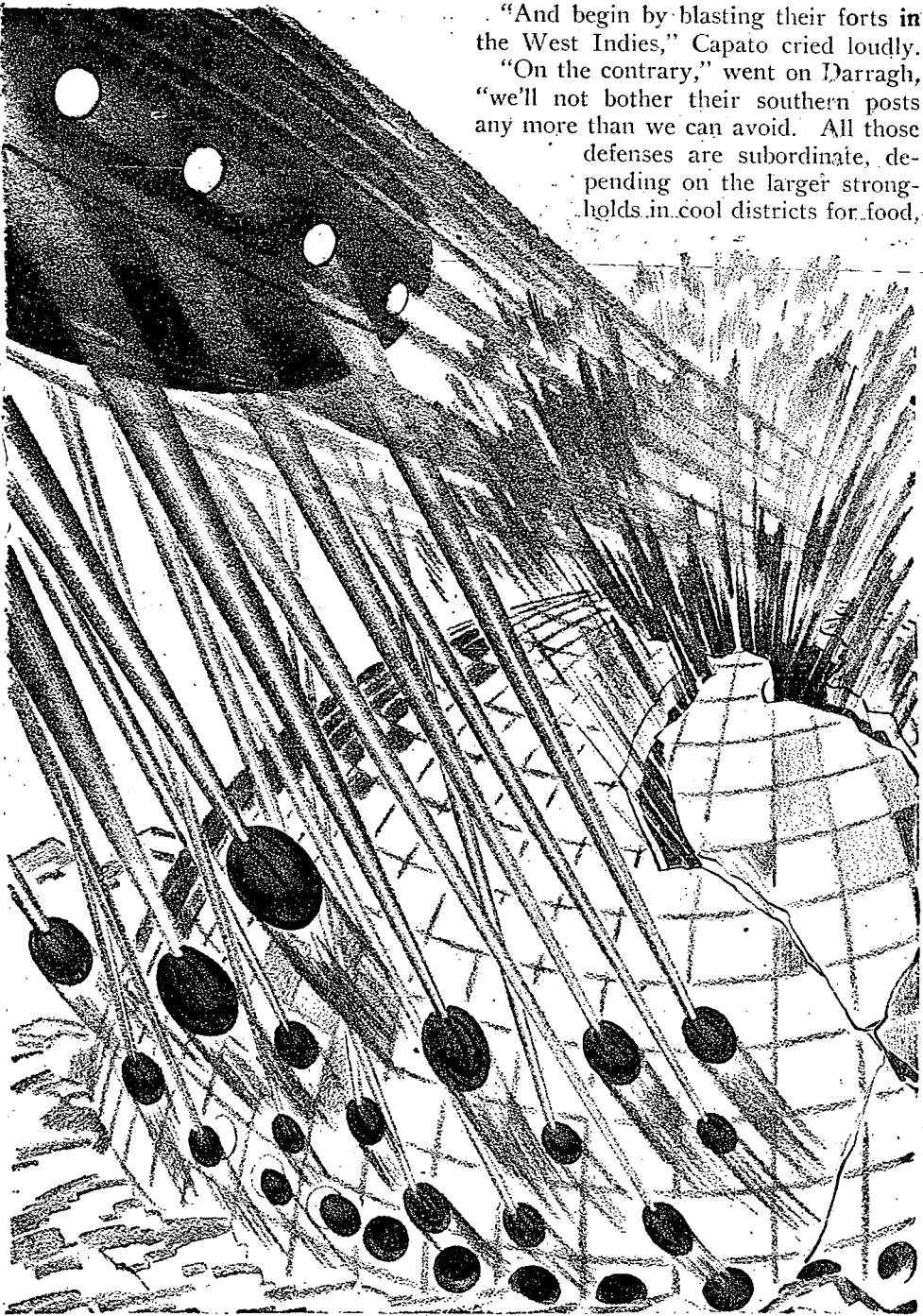
"Exactly so." Darragh paused and made sure that all were giving full attention. "We have enough of their secrets to make trouble. The two rays—green and white—we have in the form of captured machines and can now study and create. Their ships, too, we can build in our little shops and fly. With these things we shall raid them—but as mosquitoes raid."

"I still don't understand," drawled Spence.

"We'll lie low until they forget about us somewhat," elaborated Darragh. "Their guard will relax. Meanwhile, we'll prepare. With the new ships, we can send envoys and create alliances on the other side of the world. We'll prepare down to the last minute. Then, fully equipped and organized, we'll sally out—"

"And begin by blasting their forts in the West Indies," Capato cried loudly.

"On the contrary," went on Darragh, "we'll not bother their southern posts any more than we can avoid. All those defenses are subordinate, depending on the larger strongholds in cool districts for food,



In the ship, Capato grinned in satisfaction, and fled south. "They'll fix it," he nodded, "but they won't like it. We don't have cities. We're just . . . a nuisance!"

direction, garrisons. We'll hit at their main centers in the extreme north and south."

Spence nodded. "Not a bad idea," he granted. "If we could light the woods afire around their settlements, for instance—"

"Make a note of that for me," Darragh said to Brenda. "Gentlemen, we have a hundred ways to harass them, maddening and damaging ways. Powerful as they are, they're in a pretty bad fix right now. They must live in sealed domes and wear armor whenever they venture out. Even with peace, life is almost too hot for them—literally almost too hot. If we can lift the temperature only a degree or two, they can't endure it at all. And, literally, and figuratively, we'll make old Earth too hot to hold them!"

Megan started a cheer, and the others took it up. Capato made one last protest.

"I don't like the idea of being a tease fighter," he grumbled. "I won't be satisfied unless we can give them a dose of their own medicine. If we get those rays, why not blast one or two of their forts?"

"It shall be done," said Darragh. He was thinking of the great dome by Lake Michigan, its center heights held up by power beams, and of how a bomb dropped down the shaft, where once a prisoners' village had stood, would smash those "light fixtures." "If you want to, I can send you right into such a job of bombing."

"Do that," cried Capato, "and I'll vote for anything else you say!"

More cheers, and Megan sprang from the stump on which he sat.

"I make a motion," he yelled, "that we here and now form a policy of warfare and aggression along the lines suggested by Darragh, and that we name Darragh as head of this council of chiefs, with full power as commander of our forces."

"I second that motion," Capato howled

back. "All in favor say aye—"

"And never mind the noes!" finished Spence for him. He, too, sprang up, his chin-beard bristling.

"I've operated as head of this alliance," he said, "and now I'm resigning in favor of Darragh! Go ahead and vote—and let's appoint Darragh Mosquito-in-Chief!"

XI.

OF ALL MATTERS pertaining to the Cold People, the hardest to treat is that of their thoughts and emotions; and perhaps this part of the story will be most inaccurate of all.

Yet it is fairly certain that they were but mildly impressed and incensed over what happened at one of their large forts at a north temperate lakeside, a fort that had in its open central space a captive colony of human beings. Into that captive colony was driven a straggler from outside, who in some manner escaped destruction and was at first considered an escaped specimen.

He might have remained there forever, harmless and unconsidered, had not the one prisoner who could make understandable signs given information to idle watchers beyond a glass pane. When a ship with an armed party had flown in from the outside to secure the strangely troublesome individual, no real danger was foreseen. That was why, before comrades in the cold corridors of the dome knew of it, the patrol was taken off guard, overwhelmed and wiped out, and the human survivors of the battle were flying away in the captured ship.

Cold Creatures took the air in pursuit, and for awhile, especially toward the last, drew close to the fugitive vessel. When it plunged down and apparently disappeared in the equatorial jungle, the pursuers were able only to turn their vengeful rays on a town half hidden among the tall trees. Roofs of thatch, mud-brick walls, flanking thickets of shrub and vine sprang and leaped into

dusty vapor. But there could be seen no human scurriers. Apparently the inhabitants of the community had fled. No men died at the hands of that expedition, and at length the ships turned north again.

There were some scoutings after that, and some preparations for possible trouble. Undoubtedly the leaders of the Cold People saw the incident as evidence of a menacing spirit among routed human races. But months passed, and there were no more forays, spyings or thefts. The affair was almost forgotten; energies were needed to battle on this new world, so easily captured, yet so hardly maintained, so rich and various in life, yet so inclemently hot.

If only the planet could be screened from the bright, blazing sun, those garrisons must have thought; if the light and heat could be slackened by some sort of clouds, and the temperature forced lower. Well, who could tell? Perhaps a wise scientist could manage it. Scientists had made it possible to come, see and conquer. They might make it possible to hold, and in comfort.

But, if this was truly planned, it was never begun.

In midwinter, far down on the South Polar continent, a scouting ground party of the Cold People came upon half a dozen human wanderers. If it was a surprise, the surprise was complete. The men—they were all males of their species—made no effort to flee, perhaps because they knew it was useless. They stood still and submissive, with their mittened hands in the air. That gesture was undoubtedly intelligible to their discoverers, as it had been half a century before to a patrol of the Cold Ones in the American Lake Country. The men were not slain, but placed under heavy guard.

Not far away was found a heap of wreckage—an aircraft of the Cold People's make. This brought evident satisfaction to the patrol, and one may imagine them telling each other that this

must be the stolen ship from the northern hemisphere, these captives the survivors of that runaway cageful. The half dozen prizes were conveyed to headquarters near the South Pole, and there allowed to build fires in their little prison compartment. They seemed miserable from the low temperature, but greatly interested in the life factors of their conquerors, particularly the strange snow-eating vegetables that were cultivated just outside their windows.

Later they were transferred north, to a large station in the south temperate zone. Men had once built the city of Buenos Aires there. As once with another fortress and another group of human prisoners, an open shaft was rigged in the very midst of things, and scientists of the Cold People came to study and surmise. The six men did not build a representative little village—only a single low building, in which they huddled all the time. They were doing something. What?

HAD THE Cold People been apprehensive, had they been more than mildly curious, an investigation might have been made, and that something nipped in the bud. As it was, the garrison had other things to do. It was midsummer now in these latitudes; refrigeration must be increased and walls thickened.

One day, the longest of the year, the six caged humans showed exceptional activity, scrabbling busily inside their hutch, then coming out to peer at the windows, the panels, the tiny patch of sky overhead. They plainly expected a certain thing to befall, and they were not to be disappointed. Could they have had a strange warning from without—or perhaps a previous agreement? But such a thing would mean that they had deliberately allowed themselves to be caught, and what sensible creature would do that?

In any case, the phenomenon arrived—an airship, then three others, then a

full dozen, that circled and danced around the dome and did not respond to signals. The Cold Creatures were mystified and apprehensive. Every craft in their hangars was dispatched to investigate. The ray-weapons at the various ports were cleared for action, and all attention was turned outward. The six inconsequential inmates of the open central shaft were forgotten.

But they were not idle. They were busy with a green power ray—they must have smuggled in the necessary parts under their clothing, and assembled them in that dark shack of theirs. The battering force of the ray's gush broke open a panel, and through this the six hurried, dressed in the warm furs that had been their apparel when captured. They had a white explosion ray, too, with which they destroyed a Cold Creature or two as they hurried through the corridors, but their object was not combat. It was destruction.

They gained an outer chamber, with windows. Against the stout panes they directed their power ray and, when it did not immediately serve, they turned it on the fastening of the panes at the edges. A great transparent rectangle fell away, tumbled down the outer curve of the dome, and broke on the stone of the foundation. It has never been established that the Cold People had a sense of hearing, but if they had, they were aware of a lusty cheering from six exultant throats.

The warm summer air came rolling in. The men, with their rays, attacked another section of the wall. This time they used the explosive beam against cement, and the water crystallized therein responded with a noble thunder. By the time that Cold Creatures, their attention at last diverted from the mocking gyrations of the strange ships overhead, were able to make their way to the wreckers, a great ragged hole many yards in diameter had been torn.

Now was the time that the six ad-

venturers might have crept out, slid down the outer surface of the dome, and perhaps escaped; but they did no such thing. They turned back toward the interior of the fortress, and with their rays began to smash and perforate the flimsier inner partitions. As they advanced through the holes they made, they brought with them the outer heat, as fierce and fatal to unarmored Cold Creatures as live steam. By the time they were located, it was almost impossible for avengers to approach them and live. And they were able to traverse the entire inside of the dome, ripping a channel for the warm wind of outside. At a point exactly opposite their first breach, they concentrated on tearing the dome open again.

There they were overtaken, by Cold Ones in refrigerated armor. Explosive rays cut down one, then two, then four; but the surviving pair sprang from the great gash they had made, gained the earth, and sped away. One last life was claimed by a pursuing spurt of the white ray, but the other reached tall grass, eluded a swooping aircraft, and disappeared from the ken of his foes, who had too much to do as it was.

FOR THE damage was practically fatal as far as the dome was concerned. Not only was the defending outer wall torn open in two places, with warm air reaching almost every quarter of the interior, but the destroyers had attacked and ruined, by accident or design, the refrigeration controls. And so the fort was abandoned, until it could be repaired in cooler weather.

Meanwhile, the ships that had so fatally diverted attention were vengefully pursued. They showed no fight, but they were evidently flown by skilled mechanics with the greatest of concern for their own skins. They all escaped, quickly and completely. There were other descents upon the equatorial jungles in reprisal, but the Cold People could not

be sure whether any men were hurt.

As summer, leaving the south, traveled north, a second piece of shocking ill luck befell the Cold People. On an island in the north polar seas, a place once called Spitzbergen by mankind, stood a cluster of large dome-forts. Beneath them stretched the great empty galleries of Spitzbergen's coal mines, once a source of wealth and power for humanity, now scorned and left idle by Earth's masters. No longer would the masses of black fuel produce heat for civilization's furnaces; but the heat was there, waiting only a touch of flame.

Whence issued that touch of flame, none among the Cold People could tell. But it rose, ignited the coal, and in many places. Indeed, so sudden and hot a fire in the mine's heart must have come only because of the most unusual conditions for creating and spreading the flame—conditions that almost certainly needed an intelligent mind and a busy hand.

The fire of the coal veins heated the inclosing rock walls, into the cracks of which had crept age-old plugs and tongues of ice. That ice became water, then steam. Explosions followed in underground caverns, and the upper crust of earth and snow began to crack, to settle, to quiver. A small dome collapsed. Another presented great leaking rents in its sides.

Apprehensive, the garrisons poured out into the open. Not all of them remembered to don armor, and the temperature was a good ten degrees above zero, almost as much warmth as a normal Cold One could endure. There were prostrations, illnesses, and undoubtedly quarrels. Meanwhile, the subterranean fires made more cracks and craters in the snow-blanketed island.

The fortresses were doomed, and the ships on hand were not enough to carry everyone to safety. A portion fled, and when a fleet returned for the others, they were all dead.

Spitzbergen was not occupied again.

Perhaps this was because the survivors of the catastrophe remembered too vividly the ordeal of escape. Perhaps, again, it was because the Cold People had suddenly all they could do to hold their more secure positions.

For as summer advanced, other fires broke out on Earth's surface; terrible and threatening sheets of flame that swept whole continents and had to be fought back from the dome-fortresses.

Mosquitoes came with the summer.

XII.

JULY—

Spence hovered his flagship low over the wooded hills. There was forest everywhere that he could see, save where a tributary of the Yukon made a silver slash in the living greenness.

"This is a rich country," he said to his aide. "When we run the Cold People out, maybe I'll come and pan out the gold. There must be tons of it."

"Will gold ever be worth much again?" asked the aide, who was young and idealistic.

"Grab the controls," Spence half snapped. He stepped to the radio, buzzed a signal, and spoke into the microphone. "Spence, commander. Check back, all of you, if you hear me."

The receiver emitted a clucking sound. Somebody at another post was clearing a diffident throat. "Question, sir. This is Daviscourt. What if we're attacked?"

"I explained that once already," Spence reminded. "Defend yourselves, even perish, but don't run until you've unloaded those incendiaries. I want Alaska to be burning up, I say. Any other questions?"

Once more he paused. This time there were none.

"Good. Keep tuned to me, listen for my order. As you unload, turn and beat it south. We assemble at Winnipeg, pick up more bombs from the camp there, give the works to more forest.

We're burning the Cold People right out of the Arctic! Now, take positions."

Two minutes later, he yelled: "Let 'em go!" and stepped back to gaze from a port. His aide had drawn the control beads into a little bunch, letting the ship idle in midair. In all directions Spence could see his subordinate craft scattered above the forest, dropping bombs as dragon-flies drop eggs into a pool. New, warm colors began to burst through the green layer far below; then columns of thick smoke. The timber was afire.

"Enemy in sight, sir," warned his aide. A fleet of ships, flashing pale rays, had risen above a ridge far to the front. But the fire-throwers were already lightened of their bombs and were in retreat. Wagging his goat-bearded chin, Spence seized the controls and put his flagship full speed away. A few moments later, he stole another glance through a rearward port. The pursuit had ceased, in the neighborhood of the rising curtains of smoke.

"They want to put out that fire," remarked Spence. "I guess they can handle it. But it isn't the only fire today—there's more all through this woods, and through Canada and the lake country, and across the sea in Europe and Russia and Siberia. And the Cold People daren't have forest fires. Even their insulations won't shield them."

"Will these fires really wreck them, sir?" asked the aide.

Spence shook his head. "Not quite, but they'll be riled and worked to death. And that's what we're after. I wonder what Darragh's doing just now."

DARRAGH WAS entertaining a scrawny little old man at the headquarters of Earth's army of reconquest, a snug, cool cave under a waterfall of the Amazon. The oldster was most unprepossessing, with disordered gray hair and the bright, protruding eyes of a shrimp, but what he was showing had all of Darragh's attention.

"The only part of the plant exposed is hardly noticeable," the little fellow explained, "but the roots can involve whole underground acres. They secrete acid that will eat its way through the Mountains of the Moon. As I was saying, I bred these specimens up from tropical cliff creepers—"

"I want plants that will live in northern regions," Darragh broke in. "If we can wreck their colder positions, the tropical ones will collapse of themselves."

"Oh, this is a cold-weather plant," the botanist assured him. "I'll stake my life on that."

"Stake your life, eh?" Darragh squinted at him searchingly. "How would you like to go with a fleet of fast ships, to sow the seeds of your new development over all the northern dome fortresses? Yes, and over the southern ones, too?"

"I want nothing better," was the eager reply.

"Good. Gather as much of this acid-root seed as you can. If it's half as good as you say it is, it'll crumple their walls like rotten fruit. Run along now, and see me here this evening."

The botanist departed, and the orderly sent in a swarthy officer.

"Hello, Capato," said Darragh. "What's up?"

"I wanted to remind you of a promise," grunted the Indian. "You said there'd be some bombing to do, and that I could do it."

"Good," approved Darragh. "I'll start you in September."

SEPTEMBER—

A single ship moved stealthily north toward Lake Michigan, a ship small but powerful and swift. It was manned by some of the best men available in the South American forces—picked Amazonian Indians, with Chief Capato in command.

Capato's brown face was sardonic. "It

was just a year ago that Mark Darragh told me how the Cold People would give us our bellyful of fighting," he reminisced. "Well, it never happened in the old days, and it won't happen now—thanks to Darragh himself. It's us that will give them the bellyful, if they have bellies."

One of his four young men, young and slim and brown, peeped from the port. "Once I read in a book how this country used to belong to Indians," he remarked. "That big lake yonder was called Gitchy-Goomy or something like that, I think."

"If you can see the lake, our job's about to begin," Capato pronounced. He bent forward from the controls and peered. "Yep, there it is, and there's the big dome. You four bucks know your jobs?"

They said that they did.

"Good. Let's do them. There's that big dome full of Cold People, propped up with nothing but beams of green light. It ought to be a cinch."

The problem was one of precision. That was why there were four men besides Capato—one to gauge speed of the ship, one to observe the approach to the target, one to release the big bomb in its cradle below, one to keep lookout for pursuers or defense rays. Capato was at the controls. He spoke again, on a subject that was beginning to bore the others.

"In the top of this dome is a hole that goes clear down to the ground. We've got to swoop close enough to pick that hole—we'll know it by the lenses and mirrors stuck around it to throw light in. We drop our bomb down that hole, like Santa Claus down a chimney, and on the first swoop. After that they'll see us, put out defense screens of the green ray, and jump us up." He touched the control beads. "Here we go. Check our speed, Number One."

Number One fixed his eyes on the gauge. "One hundred forty point three,"

he checked. "Going faster, faster—"

"How are we for altitude and direction, Two?" asked Capato.

"A little lower, chief . . . Now we're good."

"O. K. We're going to swoop. Stand by the bomb lever, Three."

"Stand by it is. What's that vibration?"

"They're trying to signal us, I think—don't pay attention. Here we go."

The swoop, the release, the swish upward and away did not take ten seconds. The bomb went beautifully to its target, into it. There was a shaking roar that made their ship bob and skip, and the dome far beneath them seemed to quiver, to crumble.

The explosive charge had jammed the ray mechanisms far below. The shafts of light that upheld the highest curve of the great roof were winked out, things were collapsing. A ragged rent showed, warm air was rushing in to paralyze the unprepared inmates and give them a death of agony. But from the open hatchways of the undamaged lower arcs of the dome sprang a fleet of vengeful craft to engage the intruder.

"They'll never catch us," chuckled Capato, as he swung around for a retreat southward. "By Christmas time we'll be top dog again."

CHRISTMAS TIME—

Antarctica lay in wasted white crags and plains. Darragh and Brenda, almost unseeable in their snow-colored furs, lay at the brink of an icy bluff and gazed into the valley.

"That's their crop," said Darragh, nodding below. "One of the biggest fields we've found."

The snow was tufted with scrubby gray-green thickets. Bread mold, many times magnified, might look like those thickets. From such plants the Cold People drew and distilled elements that supplemented healthfully their synthetic foods.

"I understand that the Greenland communities have been pretty hungry this winter," said Brenda. "Did we really spoil their crops so successfully as that?"

"We did," Darragh assured her. "After our raying of the fields some did grow, but it was mostly volunteer stuff. Our scouts have killed one or two lone stragglers of their garrisons, and they seem to be in pretty bad condition—not living high at all."

"They're vicious," Brenda reminded him. "They're still blasting those Orinoco towns."

"Yes, but nobody's there. Our patrol ships warned the people and got them away to hiding, with minutes to spare. Raids like that hardly count any more. We don't need towns and buildings. They can destroy all of those they like."

A scratching sound was heard, and then snow broke within three yards of them. A hooded head thrust itself out, the head of Megan. He brushed a rime of frost from his black beard.

"Perfect sappers' work," praised Darragh. "Got the ray apparatus?"

"Sure," and Megan pulled into view a huge nozzlelike machine. It was hitched to a system of wires and coils, which extended back into the snow tunnel, where a generator was hidden. "So that's their little truck garden, huh?" Megan sniffed. "Their big headquarters fort must be just over the hill. You know, Darragh, for all of our fine talk a year ago, I never expected to be this close to where they live."

"We're safe," Darragh assured him. "Four of our ships are chucking bombs at an outpost dome about a hundred miles north of here. Not doing any damage, but the fuss has drawn every ship from here, even their little two-place scouters. Now hand me that ray thrower."

He point-blanked the nozzle into the valley and touched the trigger switch.

The pale light gushed, and he played

it as a fireman plays a hose. The lichen-filled valley sprang up in steam, a great violent whirl of it that fell back in a blizzard of crystals. Thirty seconds, and it was over. The crop of the Cold People was destroyed to the last vestige.

Then the three crept back into the hole in the snow. After a crouching journey of a hundred yards or more under a snow ceiling, they came to a concealed hideaway under deep ice caves.

"We did the job," Darragh told his orderly there.

"Congratulations, chief, but you shouldn't expose yourself. There's a man here to see you."

The man who pushed forward from another corridor threw back his hood. He was a honey-bearded youngster who introduced himself as Steinbaugh.

"I know your name," Darragh nodded. "You're an engineer and teacher, aren't you? Got ideas about the Alaska defenses of the enemy?"

"I have, and I'd like to talk them over with you," replied Steinbaugh. At Darragh's gesture he sat down at a table of planking, and unrolled upon it a chart.

Darragh bent to look. "This seems interesting," he said at once. "You think that you can stimulate the flow of this lava—this hot water—"

"And let it rush right downhill over their most important dome," said Steinbaugh. "Your man Spence let me go up there with his patrol ships. It's not only possible, it's practicable."

"I'll get another expert to go over this with you, and give us his opinion," Darragh announced, "and I think he'll find that you're right. Say, if we could steam them out of Alaska—"

Brenda had also come close. "May I look?" she asked. "I'm not much good, but I want to help. I want to be interested, at least."

Darragh looked at his watch. "I'm expecting someone else soon. A parson."

"What?" cried Brenda.

"A parson. And Megan and Steinbaugh can be witnesses."

"To a wedding?" demanded Megan.

"Why . . . why—" stammered Brenda. "I thought that we'd have to wait until the fighting—"

Darragh shook his head. "That may be a long, long wait," he said. "Quite probably, we'll grow old in war. But our children will have a chance to be young in peace and freedom."

EPILOGUE

MARK DARRAGH, fourth of the name and great-grandson of Earth's illustrious reclamer, was campaigning for reelection as president of the World League. He was heavy-set and humorous, not much like the lean ancestor who had made the world again habitable for human beings.

His campaign manager leaned across Darragh's writing table and straightened the great man's tie. "There," said the manager proudly, "you'll knock the television audience dead, nation by nation, when you talk tonight. What's the speech about?"

"The threadbare tale of the Reconquerors," sighed Darragh, shaking his handsome head. "People must be getting sick of my famous ancestor, who made himself such a nuisance to the Cold People."

"He saved Earth," said the manager.

"Yes, but there isn't any hero stuff for me to sling," complained Darragh. "The heroes were all killed at the beginning of the invasion. What did my great-grandpa do? He went for inspiration, not to the ant or the bee, but to the mosquito. He organized the men of the world, not to fight but to tease. He never struck a fair, clean blow; it was all surprise, all from behind, all when least expected."

"I know that Cold People died—but it

was from going hungry, or having been overheated. I know they left their forts, one by one, and concentrated their defenses—but it was annoyance drove them out, not bravery."

"It was a good twenty years of hard labor," argued the manager. "Your ancestor—all our ancestors—might not have been waving swords or yelling 'Charge—victory or death!', but I guess they worked hard and slept short hours all that time. I remember reading what your great-grandfather said in the first year or so of the business; he said, 'We'll grow old in war, but our children will be young in peace and freedom.'"

Darragh yawned. "I don't think that's quite what he said, but that's the sense of it. Peace and freedom can bore you at times."

"He wouldn't have thought that."

"No, he wouldn't. He was too busy thumbing his nose at the Cold People and then running, to make them chase him and trip over a trap of some kind."

"The campaign manager shook his head. A professional politician, he was more used to revering the mighty past. "At least he won," was his final reminder to Darragh. "After twenty years of hard and determined labor, he saw the last of the Cold People get into their spaceships and sail back to where they came from."

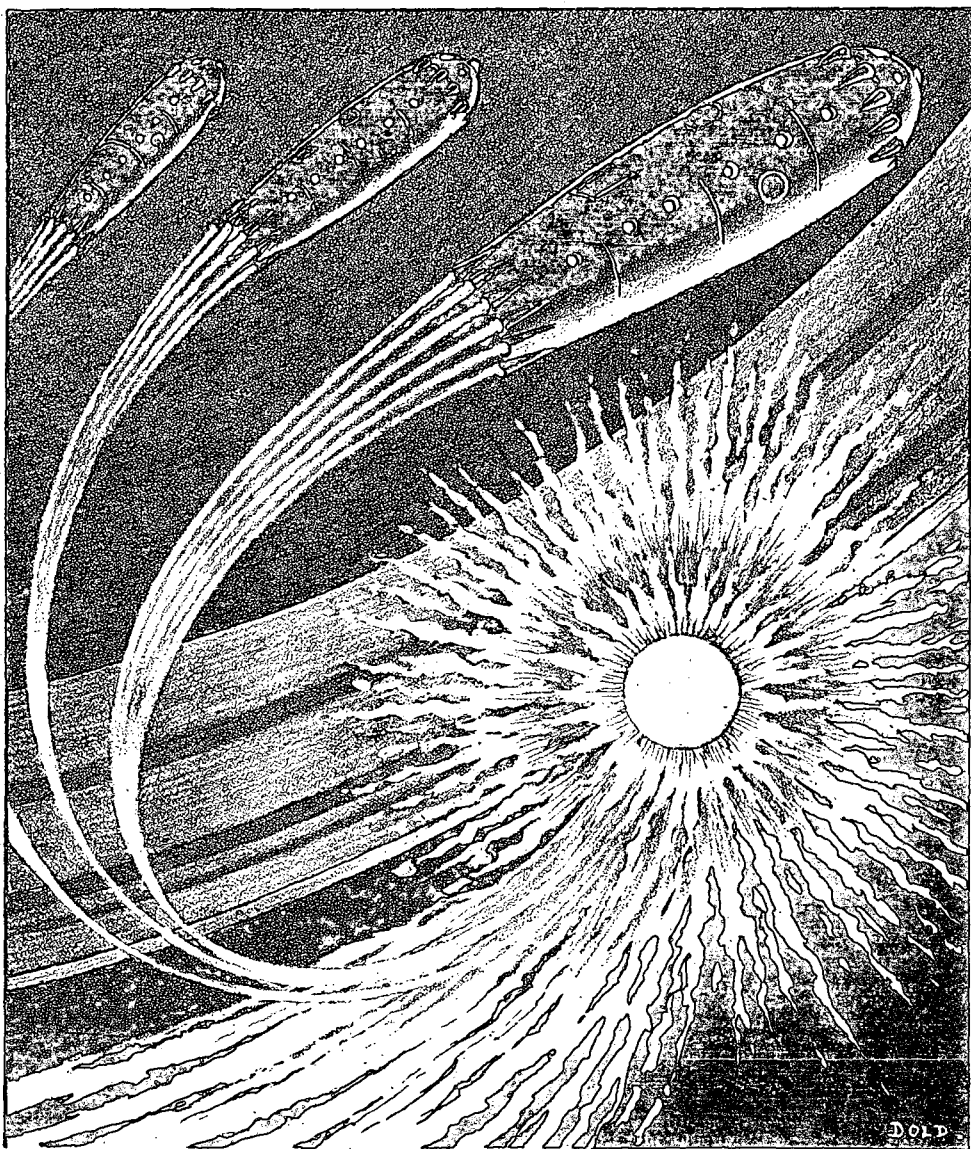
"But were those Cold People afraid?" challenged Darragh. "No, they were only disgusted. They were leaving because they couldn't stand to be bored and bothered. That sums it up. My great-grandfather was a bore."

"Well, don't you be one," warned the campaign manager. "Give the audience an earful, about how glory followed the first Mark Darragh—"

"Luck followed him, you mean," said the great-grandson of Earth's reclamer. "Anybody can be a nuisance, but not everybody can cash in on it."

THE END.

MILL of the GODS.



by
Malcolm Jameson

AST-9

MILL OF THE GODS

A small job of grinding—about a hundred miles of solid steel to be removed—for a grindstone of appropriate size and power!

WELL, what have you been doing out there?"

The windows rattled at Jed Andrews' bellow. The towering, red-faced old metal magnate glared belligerently from under bushy eyebrows at his quaking employee. They were both standing, for there were no chairs for visitors in Jed Andrews' office. Interviews with him were too short for need of them. "Say something, damn it! What about Phoebe? You've been there long enough—and spent enough!"

Asa Nutworth was really a quite promising young mining engineer—on paper, but he lacked experience and the toughness of character to cope with the hard-boiled, self-made kind like old man Andrews. The master of Saturnine Metals Corporation did nothing to make it easier for him. Bluff and bluster made him rich, and he stayed faithful to a technique that had served him well.

"The core of Phoebe is solid C₃₂, super-diamond, the hardest isotope of carbon. It is in the form of a single crystal, over five miles in diameter. To be exact, twenty-nine thousand, two hun—"

"Never mind the inches," snorted Jed Andrews, bringing his fist down on the table. A stack of books, topped by the elephantine edition of "Ores of the Saturn System" leaped an inch into the air, then crashed to the floor. "How do you know it?"

Asa Nutworth gulped uneasily, and his eyes shifted unhappily, then went on with his speech, like a frightened school-boy reciting. "The Engelsburg X-13 interferometer readings indicated its presence

and size. We sank test borings in six places, along three different diameters at right angles to each other. In that way we checked the dimensions exactly. The cores we brought up were all pure super-diamond."

"I'll say they were super-diamond," growled Andrews, caustically, snatching up a handful of monthly reports. "Chewed up seventy-four ordinary diamond cutting heads. Lord! Six holes, one hundred and eight miles deep, each—through solid meteoric iron—at twelve and a half *sols* a lineal foot! What a survey! And how do you propose to get my money back?"

"Well, sir, I was thinking—"

"Thinking be damned! *What have you done?*"

"Why . . . er . . . nothing, yet. You see—"

Jed Andrews' eyes bulged; no apparatus was needed to read the blood pressure—anybody looking could guess: two hundred ten, two hundred twenty, two hundred thirty— "Get out of here before I lose my temper!" managed the mining trillionaire, half choking, hanging onto his desk with both hands.

With the vague feeling that somehow he had offended, and sensing that he was no longer wanted, Asa Nutworth edged slowly, hesitantly, as he had come in, out of the office. Ever since he had been sent to Titan by the Dean of Terrestrial Tech in response to Jed Andrews' requisition for the "smartest damn engineer you got," he had had the feeling of fighting uphill against his employer's prejudice against college men. Yet he had done a good job on Phoebe, and he

knew it. Andrews had told him to survey it and learn its composition "from skin to gizzard, and damn the expense." Today's reception was all the more unreasonable because the old mining magnate had O. K.'d all the bills so far without a whimper.

AN HOUR later, at the time when Andrews' chief clerk was paying off the rattled and mystified young engineer (but sugar-coating the dismissal with a handsome bonus check), Dingbat Warren was parking his runabout gravicopter on the sun-deck of Saturnine's main office building. Around, spread out for ten miles in every direction, lay the shops and yards of Andrews' vast industry. Over against the ragged sierra of the Prometheus Range were the smelters and foundries. To the south, cut by the great scintillating arch of the Rings, were the hulls of scores of spaceships of every type taking shape. To the east and west were machine shops, drafting rooms, laboratories, and the other many accessories of a highly integrated industry.

His companion joined him on the ramp. Dainty, cute, utterly feminine, the first glance at her was apt to be deceptive. A second one would discover the square chin and challenging eyes of Jed Andrews, for Alicia Andrews was a fair copy of her dad. She was defiantly carrying a heavy two-foot bar of polished metal, one end of which was roughened and covered with chalk marks. He tried to relieve her of her burden, but, making a little face, she drew back.

"No, I want to grind it myself." She smiled and added, with a childlike smile. "I like to watch the sparks fly."

"Have it your way," he shrugged, knowing she would anyway. As they passed the door of Andrews *pere's* office, they grinned at each other. A thunderous torrent of profanity was welling through the open transom into the hall.

"You trot along and do your fireworks," said Dingbat. "I want to speak to the Old Man. He doesn't seem any worse than normal."

Her eyes flashed angrily, but she was smiling. "Go on in—and you'll deserve all you get in there, only don't come crawling to me afterward and ask me to patch it up."

He threw back his head, laughing, as she stalked haughtily down the hall, lugging her bar of manganese steel to the machine shop. A moment later, he heard his name announced within, to Andrews, and the answering roar, "Hell, I'm busy. Find out what he wants and tell him *no!* Hold on! Did you say Dingbat Warren? Bring him in. I want a bucket of his blood!"

"Mornin', pop. What's hot?" remarked Dingbat, casually, when he was in the presence.

"Don't 'pop' me! Save that until you rate it, which will be a long time, if I have anything to do with it." Jed Andrews wagged a finger at Dingbat. "But I do want to talk business with you, young man. What kind of hop did you slip my traffic manager to wangle that terminal contract out of him? It's the rankest piece of piracy anybody ever put over on me?"

"Hop?" echoed Dingbat, innocently, "Oh, I get it. If one of your employees does a sensible thing, he must be hopped up. Well, my little service is going to cut your turn-around on the Plutonian run by a trifling sixty per cent, that's all."

"Rats and rubbish! Never heard of such a thing."

"How could you?" challenged Dingbat, audaciously, "It's hard to get new ideas when all you'll listen to is 'yes, sir.'" He knew that the tough old industrialist whom he hoped soon to have for father-in-law had a worse bark than bite, and likewise that he secretly admired men that stood up to his bluster.

That is, if they were not on his own payroll.

Jed Andrews glared, sputtering. He jabbed a button on his desk.

"Send Tolliver in!" he bellowed into a microphone.

In a couple of minutes, Tolliver, traffic manager for the far-flung lines of Saturnine Metals, stood in the sanctum.

"Why did you take on the tug contracts? Speak up. I want this impudent spud to hear it."

"Why, sir, as you know, all our ore-carriers are low-powered ships, for economy, and slow. If we could lift one off the loading dock by a powerful tug, take it up to speed, then kick it ahead, it would coast the rest of the way as fast as a super-liner. At the destination, another tug would have to meet it, brake it down and dock it. This contract does that. It is the equivalent of trebling the motive power of all our ore-carriers. For the same operating costs, we can carry twice as much ore as heretofore."

"Har-rumph," commented Jed Andrews, sourly. "Who thought that up?"

"Why, Mr. Warren, sir. He approached me about it. I thought it was a good idea, and accepted it."

"Good work, Tolliver," said Andrews, gruffly. "That's all."

For a moment after Tolliver had faded from the room, Andrews regarded Dingbat thoughtfully. At bottom, he respected this breezy young man who was courting his daughter. Himself a successful industrialist, he had watched with approbation the aggressive way in which Warren had built up his little fleet of planetary tugs and salvage vessels until it had already become a factor in the world of industry. At the same time, Jed Andrews had no intention of approving the love match with his daughter. He could only think in big terms. In his eyes, anything less than millions was mere chicken feed.

At that moment, however, Jed Andrews was not appraising the young

man before him as a possible son-in-law, but as a resourceful business man who might be of use to him. Andrews was struggling with a problem, and had not been able so solve it—an unusual situation for him. For the first time in many years he was ready to accept advice.

"You win," he said, more calmly. "Since you're so all-fired smart, let me put something up to you, and see if you can think of an answer to it."

Dingbat Warren listened attentively while Jed Andrews told him the story of Phoebe and his operations there.

SATURN'S outermost satellite, Phoebe, had been the subject of controversy for generations. Since it revolved around its primary in an opposite directions to all the other moons, many thought it came originally from outer space. Some thought it might contain rare and valuable minerals. The Saturn System Geologic Survey had explored it to some extent, but its bulk of pure iron had defied extensive probing. Three years before, they had reluctantly given Jed Andrews the concession of surveying and mining it. The terms of the charter provided that if he succeeded in bringing in to trade a reasonable quantity of valuable minerals within that period, he might buy the satellite at a nominal price. If no actual mining were done, it was to revert to the government.

The period was about to expire, and since no mining had been done, the option would lapse. The government had refused to renew it, and rumor had it that the Martian syndicate, having learned of the immensely valuable core, had already induced the members of the council to award the satellite to them. Bribery was suspected.

"So you see, I'm out on a limb. They gave me three years, and the whole dag-blasted term of it has been frittered away by that guy Nitwit I hired. All right, he *did* find one diamond, and what a dia-

mond! But it's all in one piece, five miles across, and a hundred miles down—under pure iron! I've done some fast digging in my time, but this option expires in three weeks. Three weeks! Think of that."

"You must have known all that for at least a year," observed Dingbat, shrewdly. "What have you been waiting for?"

Andrews winced inwardly. Dingbat had put his finger on the spot that was aching him, but he laughed a little. "I was hoping, I guess, that I would think of something, or the Nitwit would, or maybe get an extension of time. If the worst came to the worst, I meant to wire these test holes with Bragwyn circuits and shoot the juice to her. Blasting is mining, under any law. Then, ten days ago, one of the Martian gang got an injunction against me. They claim if I blow Phoebe up, it will fill the space-ways with bad fragments—menace to navigation, and all that stuff. Well, that sunk me. What makes me sorest of all is that I can't find the answer—*me*, that's never been licked!"

"I could tow Phoebe in for you, as is, if you had a place to park her," suggested Dingbat. "That would take care of your option. Stuff laid down at the smelter is mined, surely."

"Oh, I thought of that," objected Andrews. "It's not practical. Did you ever try to drag a moon contrariwise through a mess of stuff like that runs around the planets? Even if you ducked actual collisions, you'd set up perturbations that'd make the inner satellites wander to hell-and-gone all over the place. I've got mines on those, too, you know."

"Why?" asked Dingbat, cheerfully. "I can drag that little lump of iron in here, and those others won't so much as wobble. The plane of her orbit leans way away from the others, and what's more, she's riding high right now. You're way up north here, and so is

she. All I have to do is break her out of her orbit and lead her in here in a nice, easy curve, and lay her down."

Jed Andrews took only two seconds to make his decision. The plateau beyond the Prometheus Range he had bought years before, to take care of future expansion. It was of continental proportions and could hold Phoebe easily. If Dingbat could do it, having the diamond alongside his plant would solve everything, even if it was encrusted with two hundred miles of useless iron. It might cause some quakes here on Titan, but—

"Done, boy! But I tell you right now, if you knock any of my chimneys down when you come spiraling in here, I'm going to be hard to live with!"

The price was discussed and settled, and it was a good one. Success would not make Dingbat rich, but it meant he could buy a couple more tugs. A contract was quickly drawn and signed.

DINGBAT WARREN found Alicia in the machine shop. She had finished polishing the piece she had carried there—a part of her own gravicopter bumper that she had broken in a bad landing, and wanted to smooth off. She had played around the shops as a kid, and was half a machinist. When he found her, she was sitting on a pile of half-finished parts, watching a swarthy grinder polish a crankshaft. The squat Titanian tending the grinding machine stood squarely in the midst of a cascade of flame and sparks. Titanians made excellent grinders, for their skin was unbelievably tough, and their crystalline eye-plates impervious to fire. Jed Andrews always employed them. It kept his compensation costs down.

Seeing she was sitting, fascinated by the rain of sparkling light from the gritty cutting wheel, and pretended to ignore him, Dingbat did not speak, but stood patiently nearby. Idly he surveyed the busy shop, listening to the screams of

the tools cutting the hard alloys used in spaceship construction. Like Alicia, he let his gaze drift to the cataract of fire, and fell to planning how he was to maneuver the Phoebe.

Of a sudden, something clicked inside his brain. Abruptly he snapped out of his reverie and began watching the operations of the flame-bathed Uranian with avid interest. The germ of an idea that flitted into his mind flowered into a full-fledged plan. Flinging "I'll be right back" to the preoccupied Alicia, he dashed out of the machine shop.

Back in Andrews' office, he found the old man staring savagely out the window toward the Prometheus Range.

"That's going to be a hell of a lot of iron to get rid of," he shot at Dingbat, thinking of the two-hundred mile sphere of iron that would loom there, if Dingbat did not get tangled up with the inner satellites.

"Oh, the diamond core is all you want, is it?" asked Dingbat, mildly.

"Yes, you damn fool! Why should I want iron?" bristled Andrews. "But, boy, the diamond! It will be worth trillions. The army and space-force alone—"

"That's what I thought," interrupted Dingbat. "Please sign this additional clause I've had inserted."

Jed Andrews glanced at him sharply, and seeing he meant it, puckered his brow and read, *"and for delivery within the agreed time of the central core only of the said Phoebe, consisting of one super-diamond, the compensation shall be, in lieu of moneys stipulated elsewhere, one-third the value of the said diamond."*

"Why, you four-flushing young whippersnapper!" exploded Andrews. "So you're getting high and want to show off? Well, if that's a bluff, you're called. Emily! Bring your notebook!"

A fluttering stenographer slid into the room.

"Change this to read," he grunted.

"'in addition to' where it says 'in lieu of,' and change 'one-third' to read 'one-half.' That's pouring it on you, boy. Now put up, or shut up!"

"Thanks," grinned Dingbat, picking up the signed paper. At the door, he turned and asked, "and if I do, can I call you 'pop'?"

"You can call me anything. Get out of here!"

Bound back to the machine shop, Dingbat bumped full tilt into Nutworth, just emerging from the cashier's office, still dazed at the manhandling he had received from the cantankerous Jed Andrews. Hastily apologizing, he was about to dash on, when he recognized the unhappy engineer who had made the survey of Phoebe.

"You're just the man I'm looking for. Want a job?"

"Well, I haven't one, but—"

"You have! Dingbat Warren's Sky Wrestlers, Inc. That a sky-tug outfit?"

"But I don't know anything about tugboats."

"You're going to." Dingbat shoved a card into the surprised young man's hand, and telling him to meet him there in an hour, rushed away. By now, he figured, Alicia had tired of watching the manganese sparks and was probably steaming up to spit some of her own.

ON BOARD the super-tug *Thor*, hurtling outward from Titan with all her stern jets spewing fire, Dingbat clung to the grips of the starboard observation port, intently studying the play of light from the iridescent Rings below. No matter how often he passed them, he always did that. There was more than the strange beauty of the multicolored whirling bands to appeal to him; there was the intellectual interest in the superb precision with which the myriads of tiny globes kept station in the endless procession around Saturn.

He did not care whether the Rings

were the unused parts of a planet never built, or the debris of one that fell apart. But he did know that that planet, if it ever existed, was all of quartz. The rainbow hues of the dizzily sweeping disks were due to the helter-skelter mixture of amethyst, clear, rose and smoky quartzes, jasper and agates, mingled and ceaselessly succeeding one another in their race to nowhere. They flowed along, some spheroids five or ten miles in diameter, most somewhat smaller; the interstices partially filled with clouds of smaller particles, ranging from boulders on down through sand and gravel to the merest dust. Due to its speed, the Ring looked solid, a polished sheet of opalescent glass, but Dingbat knew its real composition. He had spent a vacation prowling through its interior.

When the Ring had slid out of sight under the quarter, and Mimas hung glimmering below, Dingbat turned away and began considering the details of what he had to do. The mining engineer, Nutworth, was disconsolately pacing the cabin. He regretted coming on this expedition, for there appeared nothing for him to do. No one had told him yet what he had been hired for. Violent and unaccountable people, these Titanian colonists, he was thinking. In a single afternoon he had been summarily dismissed by one whose orders he had carried out implicitly, and as promptly hired by another who seemed to have nothing for him to do. Nutworth was a conscientious fellow, and he felt he should be doing something to earn his pay.

"Tell me all about the big diamond inside Phoebe," demanded Dingbat, noticing him for the first time.

NUTWORTH brightened. Eagerly he told all he knew. It did not take long. The diamond was a special form of carbon. It had no known melting point, was of tremendous hardness, was probably a crystal of many million faces, probably nearly spherical. The

fact that it was combustible gave Dingbat a moment's worry, until he remembered that oxygen is needed to let something burn.

"Thanks," said Dingbat, and left Nutworth to his own devices. On the quarter, following the *Thor*, were two other powerful tugs, the *Kwasind* and the *Hercules*. Dingbat called their captains to the televisor and outlined what they were to do. Jed Andrews had said that all men and equipment had been withdrawn from Phoebe and the moonlet was deserted. This was well, for there was little time to spare. They could hook right on.

A week later, the Phoebe was rolling inward, well on her way to Titan. Her course led around Saturn in a great arc, and out, then, to Titan. Clinging to her, spaced equally about her on a great circle, were the three tugs, all pushing. By varying their jet velocities, Dingbat could manipulate his tow as he chose. He was utilizing all her own momentum, coming in on a spiral counter to the revolution of the other satellites.

Saturnward and down lay the bright plain of the Ring. From the *Thor* it appeared as a glittering continent stretching almost limitlessly to starboard. Its near edge was racing toward them, Dingbat knew, at tremendous speed. It looked as thin as cardboard at his distance, despite its forty miles of thickness. Now, if at all, he must launch his daring experiment.

He had no great misgivings. He had confidence in his theory—even if the idea was impromptu. But there was never any certainty in the outcome when colossal forces of nature are brought into play in a novel way. Unforeseen factors could easily make the difference between triumph and ruin. But it was do or die now. After what Andrews had said in the office, Dingbat would not draw back. He reached for the televisor control.

At his curt order, the tugs turned the

helpless Phoebe downward. Dingbat turned his attention to the Ring, which now appeared to be tilting slowly up toward him. When it had risen until it was edgewise to him, he gave another signal and the tug masters leveled off, heading their tow toward a point on the edge of the Ring far ahead. Self-reliant and cool as he usually was, Dingbat felt gooseflesh rise as his calculations showed him his zero hour was but a few minutes off. When once he had let go of Phoebe, the matter would be out of his hands. Nature would have charge. Time only could tell whether she would handle it as he had visualized it. "Stand-by" he ordered, grimly, squinting at the chronometer; then, "Give her the works!"

His other tugs cast off, flaring their bow tubes to deliver a parting kick to the doomed Phoebe. Dingbat himself clung to the satellite a couple of minutes longer, surging forward with all his power to start the moonlet spinning. Then he, too, administered a final kick and backed away. The released Phoebe shot forward like a gigantic bowling ball sent down the black alley of space by some vast giant. Dingbat sighted over the fast receding sphere. His calculations had been perfect; she was heading squarely for the edge of the Ring. His work, for the moment, was done. The urgent need was to find a safe place. The *Thor* shot upward, climbing frantically, followed by the other two.

AT THE INSTANT when he felt high enough to be secure, Dingbat leveled off again. Well above the plane of the Ring, he could look ahead and down to the speeding iron ball. Phoebe was very near to the periphery of the Ring now, approaching at a small angle. Shortly she must collide with it. Their directions of movement were opposite, and Dingbat involuntarily shuddered at the speed of impact—it would be at least sixty miles per second!

"Too bad," commiserated Nutworth, who was also looking out the port. "Got away from you, didn't she?"

"Put these on," commanded Dingbat, shortly, handing out space goggles.

Phoebe struck. A dazzling green flame shot out, straight as an arrow, flaring back thousands of miles along her wake. The region from which the tugs had just escaped was sheer flame. About the buffeted sphere that had been Phoebe, a corona of incandescent iron vapor was pluming, streaked with beads of molten iron bursting into sparkling rosettes, while ricocheting quartz spheroids bombarded space above and below the Ring. Instinctively, Dingbat shut his ears with his hands to shut out the screech he expected to hear, forgetting that in the void there is no sound.

"What on Earth!" stammered the frightened Nutworth. The crew members looked at Dingbat in awe.

"Cosmic grindstone," tersely explained Dingbat, "a little job of diamond polishing."

Now that he saw the limits of the danger zone, Dingbat pushed his ships ahead. He wanted to get as close as the spurting flames and wildly leaping quartz particles would permit, for when Phoebe had spent her momentum, he still had the tricky job of diving in to salvage the diamond. He could plainly see by this time one hemisphere of Phoebe sticking up through the upper surface of the Ring, and it was white hot. The hurricane of sand and gravel impinging against the iron moonlet was abraiding it away, and the friction was heating the iron as it was torn from its base. Now and then, a blinding burst told of the collision with one of the larger quartz spheroids. Dingbat thrilled, thinking what the spectacle must be, viewed from Saturn.

His first reaction had been one of elation. His idea was working! His main fear had been that Phoebe would lose her velocity before the sandblast of the Ring

could strip her clean, and he would have to lug home a misshapen thing. But when he looked again, his complacency left him. There was something wrong down there. He had used foresight, but not enough. In giving Phoebe his last push, he had set her spinning, so that when she was in the rushing Ring stream, she would roll over and over, allowing it to gnaw her evenly on all sides. With a gasp of dismay he realized that this was not happening. Instead, Phoebe was spinning madly about an axis vertical to the Ring! In striking the Ring, the impact of the edge had applied a torque that had started a violent rotation about the wrong axis.

Dingbat's first impulse was to dive and risk another push. But as he approached he saw too clearly that the searing envelope of lurid iron vapor and the flying gobs of fused quartz made that certain death. Even if he could penetrate that barrage, it was questionable whether the glowing sphere was solid enough to receive the thrust. There was nothing to do but hover and watch. The blast of Ring material was slotting the Phoebe through the middle. The moonlet was over two hundred miles in diameter, the disk but forty thick. The battered satellite was being severed like an apple being fed into a buzz saw. Its core was a priceless diamond, and would soon be reached, and swept away.

DINGBAT had hardly realized the inevitable effect, when the thing he dreaded happened under his direct gaze. With a final outpouring of flame, the white-hot nucleus of Phoebe was swept out from under its polar dome, and away in a swarm of struggling quartz globules. The white-hot domes, no longer held apart by the center, now collapsed into the Ring, and in their turn began to be eroded. Dingbat sprang into swift action, for he knew that to lose sight of the diamond meant to lose it. Once cool, and mingled with the tens

of millions of similar quartz spheroids, it would circle perpetually with them about Saturn. There would be no finding it, short of a miracle. He must turn and pursue it now!

Desperately the tugs tried to kill their momentum in the direction Phoebe had originally started. Enveloped in flames from the flaring jets bucking space, observation from the *Thor* was impossible for a time. When she and her sisters had managed to turn and had begun to pick up speed in the direction of motion of the Ring, Dingbat's anxious scanning of the curving plain ahead showed him nothing. The diamond, last seen well within the Ring, had disappeared. Now there was no sign. Savagely, he ordered every ounce of speed crowded on.

Ten minutes later, far ahead, there was a momentary burst of white light, followed by a fanlike eruption of greenish flame. That indicated the diamond still had a little velocity left in their direction, and had just had a collision with a quartz sphere. Dingbat snatched a little hope. As long as the diamond was fighting upstream, as it were, signs could be expected. Cursing helplessly because there was no more reserves of speed, Dingbat paced the cabin until the *Thor* had built up to Ring velocity. The sight of the glimmering ten-thousand-mile width of the Ring added to his dejection; systematic search of it was an impossibility.

When the moment came that the tug was traveling exactly at the speed of the Ring fragments, all hands peered below. As by magic, the Ring ceased to be a solid. Below, as if hanging motionless in space, were bodies, millions of them, of every size and color. The spaces between them were large, comparatively. A space-ship, handled with care, could safely be taken in.

As he gave the order, he noted for the first time that in the excitement of the day, he had forgotten the passage of time. In scanning the part of the

Ring ahead, where he thought he had last seen the diamond, his heart sank when he observed that that spot would shortly pass into the shadow of Saturn. His search would have to be made in the dark. What had seemed to be difficult enough was about to turn into an impossibility. Unless he sighted the diamond before dark, it was lost forever!

At that moment, in the very edge of the penumbra, a dazzling beam of purest blue, changing instantly to a gorgeous crimson, shot forth. It vanished as quickly as it came, as its source went into the shadow. The diamond! It could be nothing else. A groan went up from the crew. Everybody recognized now that with another hour of sunlight, there might be a chance of securing the gem. But now?

THE THREE ships groped through the packed recesses of the Ring, their lights creating an eerie scene. Nowhere in all space is there another such area. All about them were the ghostly spheres, each reflecting the light differently, depending on its color and crystal form. Hour after hour they tested one big quartz globule after another, hoping to get back the answering flash of the superb jewel. False hopes were raised—and dashed. Men grew tired and sleepy.

"Titan calling," announced the television man.

"Don't answer," replied Dingbat, glumly.

"If it's any help, sir," ventured Nutworth, "I just remembered—diamonds phosphoresce under the impact of an electric discharge."

"No good," said Dingbat, gloomily, "these are tugs, not war cruisers."

Nutworth relapsed for a moment into his ordinary state of worried abstraction, then brightened and added; "And under ultra-violet light, too."

"Now you're talking," cried Dingbat,

coming to life again. Orders rang out and the crew of the *Thor* swarmed all over the place, rigging transformers.

The scene outside, if bizarre before, was absolutely weird now. The flood of violet light made the strange particles in the neighborhood look like the embellishments of a fever dream, glimmering in the ghostly light. Many pieces were discovered that gave off a mild fluorescence. These were successively examined and rejected. The ships went on, casting their invisible light ahead. Presently, back from the black void ahead came the glorious brilliance of the answering flame of the diamond.

"Phoebe, come to papa!" half sobbed Dingbat, delirious with relief. The crew needed no orders. They did what was to do. Dingbat danced round and round. Grabbing the amazed Nutworth, he pumped his hand up and down.

"Nutworth, old boy, I apologize!"

"For what?" asked the bewildered engineer.

"Never mind," said Dingbat, sobering, "but you get a bonus, too."

The *Thor* had hooked onto the diamond, and it was not yet dawn.

"Saturnine Works," Dingbat ordered, crisply, "and mind the chimneys."

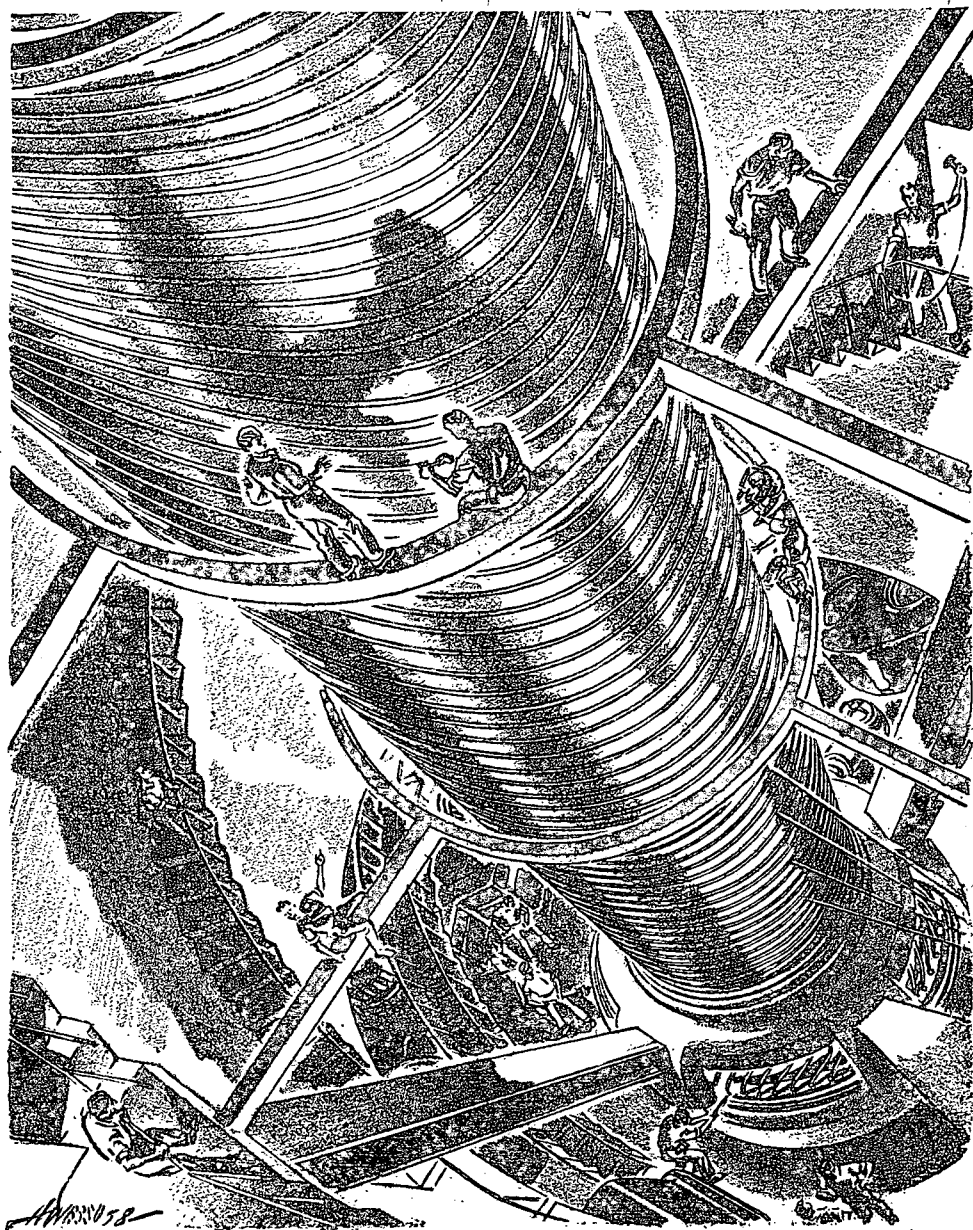
He went to the television and switched it on. In a couple of minutes he was looking into Jed Andrews' office. Before he could say a word, the old man started roaring.

"What in Hell! Every astronomer in the Solar System has gone crazy!"

"Tell 'em everything's under control," and Dingbat switched off. The old man could wait. He was looking for Alicia and the glimpse of the office showed him she was not there. Now he called the Andrews mansion on Tethys Heights. Ah! There she was.

"Hy'a, hon! Listen—there's an old Earth custom that, when the boy friend brings in a big diamond, the girl sets the date. I'm on the way!"

"THE FIRST SHALL BE LAST"



by Arthur J. Burks

"THE FIRST SHALL BE LAST"

Josh McNab and Skipper Parsons renew their fight in a race from Uranus to Pluto

NOBODY could have felt worse about the change of status than Chief Engineer Josh McNab. The *Arachne*, first of the spider fleet of spaceships, first to use gravitic lines of force as a means of travel, had been turned into a freighter! Oldest of the line, it had been, in effect, relegated to the scrap heap. Never again would the belt promenade resound to the laughter of tourists to Mars and Uranus. Martin Caperton, the owl-eyed owner of the Caperton lines, had decided he could make more money with her by making her a freighter, victim of the whims of commerce.

The *Arachne*, hereafter, would be ruled by the dollar, the pound, the uranid, or whatever the medium of exchange was on a given planet, and would carry whatever cargo proved the most profitable. She had become, in effect, a tramp steamer of interplanetary space. And Josh McNab didn't like it. He had always liked to be where people were, even when they laughed at the Scotch bur in his voice.

There was just one thing that pleased him, made his new lot bearable: Captain Lee Parsons had been left in command of the *Arachne*! Captain Lee Parsons, who liked snappy uniforms, and enjoyed strutting his fine figure, showing his authority in front of the ladies. Now, he'd have to strut for McNab, if he strutted for anybody, and he knew exactly what McNab thought of him—so he probably would never strut again. Moreover, the *Arachne* carried a brand-new crew which had never heard of grand uniforms. Their clothing was greasy, disreputable, impossible and Parsons had given up, the first week, trying to make them com-

port themselves or dress like the crews of the streamlined passenger jobs.

McNab chuckled as he thought of the vast clouds of gloom that had hung over the *Arachne* ever since she had been turned into a freighter. Right after it happened, McNab heard Lee Parsons call Martin Caperton all the evil names he could think of—and McNab chuckled, remembering how often he, Parsons, had called McNab down for using even milder terms of abuse for the old Caperton skinflint.

The *Arachne*, approaching Uranus, was about to do her "somersault" and lower away for that planet. She had made a record run from the Earth, carrying cargo consisting of everything—almost literally—round the sun. Her cargo holds had been jammed. Her belt promenade, whereon so many passengers had traveled and walked in times past, had also been packed with junk. So had erstwhile staterooms. Caperton hadn't yet gone to the expense of ripping out the staterooms entirely.

It had been a real job, conning the *Arachne* along the lines of force from the Earth on her maiden freight run. For, built for passenger service, cargo had hitherto always been carried well below the belt promenade. Still, thanks to the spacemanship of Parsons—McNab gave the skipper that much credit—the trip had been a success. But that very fact made for additional gloom—because a record trip with a big payload, simply meant more and more of the same.

The "somersault" completed—that is, the *Arachne* having reversed ends, to land bottom-down on Uranus, instead of headforemost—McNab joined Parsons in the control room, in the nose of the

ship. He walked the circular staircase in the Tunnel—that bore through the middle of the two-hundred-and-fifty-foot-long *Arachne*, wherein the mainline helix spun, swallowing gravitic lines of force like spaghetti, and speeding along those same lines at miraculous speed, dragging the *Arachne* with it—and tried to pretend that she wasn't a freighter after all.

Without actually turning around, he could see, as from the back of his head, the different levels of the ship, clear back down to the cargo holds and the "bilge," or keel; back down to the accumulators storing electric power for spacial emergencies; the atom converters with their endless musical humming; back down to the oxygen and water tanks, air apparatus, all auxiliary functions—and the D.C. motor! *There* was something! Forty thousand horsepower, series wound, capable of revving up to 35,000! Josh McNab loved that motor, hated to leave it, even to bait the disgruntled captain.

He glanced at the mainline helix which wound around the rotor shaft—and looked away again. That helix and rotor were miracles he hadn't yet become accustomed to, despite his years of handling its functions. It was weird and unearthly. Of course—since by its magic the *Arachne* moved like a comet between the planets.

HE SIGHED, entered the control room at the top of the ship. Parsons, dressed in immaculate uniform—it was too soon in the freight service for him to let down any, McNab decided—turned a gloomy eye on his chief engineer.

"One kidding crack out of you, McNab," he said, "and I'll pin your ears back! Don't bother to tell me what you came to tell me. I know it as well as you do! We've made a record trip with our first load of freight but will that give us a break? Will old Caper-

ton, now, relent because we're good, and return the *Arachne* to passenger service, or give me one of those streamlined jobs? Nix! He'll just give us more of the same, until all of us together—you, me, and the *Arachne*—fall apart like the one-hoss shay!"

"Aye, sirrr!" said McNab. His gray eyes were wintry. The tufts of hair that thrust forth from his ears made him look like a grizzled porcupine. At fifty, Josh McNab was as hard as nails. Tough as they came, was McNab. And, privately, he thought Parsons a stuffed shirt—and not always privately, either!

"And did he make my lot any easier by leaving you as my chief? He did, not!" Parsons was vastly aggrieved. "He transferred everybody else, but leaves me Josh McNab—the unintelligible Scotchman who's been in my hair all these years!"

"Th, day'll coom," said McNab quietly, "when ye'll ha nae hair. Skipper! Then ye maun worrit yoursilf nae mair!"

"You've spent all these years, McNab," said Parsons, "razzing me. Some day I'm going to give you your come-uppance."

"My worrk is satisfactorry, sirr?"

"Yes, blast it! That's just the trouble! You keep just within the letter of the spacial law—but I can read those eyes of yours like a book. You despise me; I detest you!"

"Aye, sirr!" said McNab. Parsons decided not to press a question that occurred to him—whether McNab's affirmation had to do with his detestation of McNab, or McNab's of him. In all probability the latter was intended!

"And now, to cap it all," said Parsons, "we make a record trip and simply lower ourselves more deeply into the slough of our despond."

"Aye, sirrr! Yon engines worrrkit their best, this trrip, sirr!"

McNab's eyes were twinkling. Parsons gritted his teeth.

"Yes, and *you* made sure of the rec-

ords trip, just to get my goat! You'd rather spend the rest of your active service in a freighter, than see me get a break!"

"Aye, sirr!" said Josh McNab.

Then both turned their attention to the helicopter tugs that were spearing out from Uranus to warp the *Arachne* into her landing stage on the surface of that planet. McNab always thrilled to that sight, though this time he had an idea the tugs would handle the *Arachne* as though, no longer a passenger liner, she were slightly soiled. McNab himself would never feel that way—the *Arachne* had been his home so long—because, after all, it wasn't the *Arachne's* fault that old Caperton was a miserly skinflint.

Still, McNab did miss the ladies, the laughing, joyous passengers. He wouldn't have minded having a flock of lovely young women around him right now, even if they *did* mimic his Scotch brogue!

At any rate they'd soon be in port, and McNab had a private date with himself, to slip around the nearest corner, and fill his gullet with the fieriest brew Uranus could offer. Maybe it would knock him for a loop, and he could forget the ignominy to which he had been reduced. Uranus hadn't been settled long, and its liquor was almost as raw as its pioneers. None of the planets had been settled very long. The first, as he recalled it, in 2020 A.D. No living man could recall that period, of course, but, as time went, it was just yesterday, and new generations in Uranus were just about now orienting themselves. They hadn't oriented their liquor at all. One drink of it—

"And there'll be no boozing this trip McNab," said Parsons, as though he read the mind of his chief, "for no telling, we may have to leave for almost any place—even Pluto, for all I know—the minute we land and get unloaded. After all, McNab, we are the playthings of

chance, the victims of the whims of our slave master, Martin Caperton."

"Aye, the scut!" said McNab. Tentatively, he called Caperton a few names, in the presence of Parsons. Hitherto, when he had dared criticize the owner of the tremendous spider fleet that plied among the planets Parsons had always called him down for disrespect.

Now, however, Parsons leaned against the controls, looked at McNab, and said: "Get it off your chest, McNab. You know more words than I do, all of them bad and expressive, and I'll nod to each vile name!"

For fully ten minutes, during which McNab didn't repeat himself once, or change the expression on his face, the chief blistered the far-distant Caperton with all the superlatives—backward—he could think of, and Parsons nodded. Thus, for the first time in memory of either the skipper and chief appeared to be in agreement.

URANUS—

Disgustedly Parsons and McNab, properly dressed for a brief sojourn on Uranus, left the egg-shaped *Arachne*. Regardless of warnings, McNab headed for the nearest liquor store, trying as he went to recall the name of the hardest liquor obtainable. Then he'd buy a big bottle, and down it all without taking a breath. Maybe it would even kill him, and his troubles would be over.

"Remember, McNab," said Parsons, "no liquor!"

"Aye, sirr!" said McNab; but he grinned and smacked his lips. After all, he wasn't aboard ship now, and Parsons couldn't boss him *too* much. He made the bar he had in mind, while Parsons headed for the office of the Caperton lines, Uranus branch, to report and ask for orders. Fearing there might be some, McNab named his poison, downed about five fingers of it—enough to make him think, almost instantly, that he had stepped off the *Arachne*.

somewhere between worlds!—and waited for his head to quit wobbling long enough to let his lips connect with the bottle for another libation.

The bottle was yanked from his hand. He spun—almost going down—and stared into the blazing eyes of Parsons. For a moment he thought Parsons was going to brain him. But no—Skipper Parsons, the teetotaler, upended the bottle and took five fingers on his own account.

He gasped, gulped, swallowed. His face got red, purple, and indigo. Then—

"Orders, McNab! Orders, and of a kind that only old Caperton would hand out. Where, my hairy-eared friend, do you think we go next—as soon as we get rid of the junk we brought here?"

"If I ken th' mon nichtly, sirrr," said McNab, hiccuping, "oor next port o' call'll be Pluto, because it's lang an' lang frae Uranus!"

"Right the first time, McNab! It couldn't be farther away, and still within our reach. Pluto it is, and do you know what for? To take aboard something precious—Element 103 no less! A sniff of it costs enough to float the bond issue of Earth's biggest city. And, says Caperton, we proceed thence at once, at our best speed. Besides which, a rival company—Interplanetary Rocket Ship—has already started a ship from Earth to Pluto. Caperton says we're to beat the rocket ship there—first ship to arrive gets the gravy, meaning this Element 103—or not to bother to come back!"

McNab so far forgot discipline as to grab the bottle from Parsons, down another slug. Then Parsons snatched it back. The two wove out of the bar, hanging onto each other, and made the landing stage without mishap—except that they dropped the bottle and broke it.

Not until they were inside the *Arachne* did either note how friendly they had become in their mutual despair. Then they stood off and swore at each

other roundly, bitterly. All the while Uranian stevedores were working at top speed to free the *Arachne* of her cargo.

IT WAS DONE by the time McNab and Parsons began to feel the first ghastly terrific pangs of an Uranian hangover. Then Parsons, white of face, gave the command: "Cast off for Pluto!"

"Na, na, sirrr!" objected McNab. "Dinna ye ken whur she is in her orbit the noo? As fur fra here as she maun be!"

"A straight line, McNab," said Parsons, "is the shortest distance between two points."

"Aye, sirr! But nicht for aye th' quickest!"

"Drive her full speed for Pluto!" reiterated Parsons. McNab shrugged, quitted the control room, entered the Tunnel. Already the *Arachne* was being pulled and hauled out of her berth by the helicopter tugs. In a matter of seconds, almost, none aboard the *Arachne* would be able to see Uranus for dust—which brought a pang to the heart of McNab, except that he had remembered to secrete a second bottle of Uranian brew on his person. Did he dare—

He did! He stepped back, opened the door, tossed the bottle to Parsons. After that he simply kept his Black Gang busy with the mainline helix, rotor, and D.C. motor, long enough to give the Uranian brew time to work. Then, quietly, he reentered the control room.

Lee Parsons was standing upright, with a vacant stare in his eyes. McNab, studying him with a judicial eye, thought he had become as near a human statue as a man could. He shifted him away from the controls, and did a strange thing.

He shifted the *Arachne* off the main lines of gravitic force connecting Uranus and Pluto—and headed her directly along the mighty lines of force that led

toward the blazing heart of the mighty Sun! Just how, one might have asked, did McNab expect to get to Pluto by setting a course for the Sun—which took him almost at right angles to the Uranus-Pluto course?

One result was instantly apparent: the *Arachne's* speed became dazzling. There were, really, no words to express how dazzling—without using similes comparable to comparative distances between planets, or—well, to express the difference between the speed they had been making toward Pluto, and the speed they were now making toward the Sun.

McNab glared at Parsons.

"Strong is th' brew o' Uranus!" he said. "Or ilse silf-pity ha unscrewitt yon skipper's head!"

Now he grasped the skipper, lowered him—stiff as a board—to a cot, where Parsons began to snore. Then McNab, grim of face, went back into the Tunnel. He began his own working of miracles on the D.C. motor—and the acceleration of the *Arachne* picked up yet more. The Black Gang sweated under his command. The webwork throughout the *Arachne*—stress-bearing, mighty girders whose creaking was a language that McNab loved to hear, slanting out and through the great hull from the control room—protested at the strain. McNab knew, though, listening, that nothing interplanetary could wreck the *Arachne*.

He knew he must be well on the mad way to the Sun before the skipper snapped out of the wallop Uranian brew had handed him. Faster and faster grew the Sun before the *Arachne*. McNab chuckled. He had already pulled far enough away from the Uranus-Pluto force lines to make it unfeasible for Parsons to turn back—though the skipper was hardheaded and stubborn—

"McNAB!" The shriek, filled with agony—perhaps of a bursting head—came crashed down the Tunnel. "Mc-

Nab, you double-crossing highbinder, what are you doing? Who told you to change course? Why are we heading toward the Sun?"

"Th' shartest dstance, sirrr," said McNab, looking up at the savage face of the skipper, "isna the fastest. So, sirrr, when ye were oot like a licht, I changit th' coorse!"

"How the devil do you expect to reach Pluto by heading for the Sun? It's at right angles, or almost, to the right course. Get back on it, at once!"

"Aye, sirrr, if ye insist. But I'd e'en point oot, sirrr, that time losht ratairnin' would be fatal!"

"Then, when, and if, we get back, I'll report you. By heavens, I'll put you in irons, right now!"

"Aye, sirr!" said McNab, unperturbed. "Will ye notice, sirrr, th' grrrand speed we're makin'?" McNab's eyes were wickedly twinkling.

"And nobody but you can make her travel like that, eh? Well, I get it, all right, but it's insubordination, just the same."

"I dinna disobey, sirrr!" said McNab.

Parsons, remembering, gulped and swallowed. After all, McNab, in the absence of instructions to the contrary—since the skipper had been pie-eyed—had changed course. If, in a later hearing for insubordination, it were brought out that Parsons had imbibed freely and too well, Caperton, who neither drank nor smoked, might—

Parsons shuddered at the prospect.

"All right, McNab. You don't know what you're doing. But get this straight: When we reach a point where a line drawn between us and Jupiter would pass midway between Earth and Sun, we swing onto the Jupiter force line, understand? I grant you that though the Sun's mass makes the lines of force between Uranus and the Sun terrifically powerful, you had no right to change course at any time!"

"Aye, sirrr!" said McNab, grinning.

The crew looked up at the arguers, a bit startled. McNab understood why. They were thinking, perhaps, what it would be like if they were unable to free themselves of the Sun's force lines, unable to decelerate—and were flung into the Sun's heart. Millions of miles away they would be shriveled into cinders too small to be felt in the human eye! They looked doubtfully at McNab.

"Dinna ye fret, bairns," he soothed them. "Yen skipper kens th' richt o' things!"

If they remembered that they were traveling a route set by McNab, and not Skipper Parsons, they said nothing. But they worked even harder at their various tasks—and perspired like hippos, a fact which kept them all in a dither, considering the direction of their flight. McNab grinned.

The Black Gang was scattered like monkeys in the Tunnel. Keen eyes watched the mainline helix, searching for flaws, cracks, anything, however slight, which might impair the efficiency of the weird, miraculous gadget by which the *Arachne* traveled.

Parsons yelled to McNab again, commanding him into the control room. His face was white.

"You fool, McNab!" he said. "We haven't a chance. Just had word about the rocket ship. It's making record time. Her master is giving us the ha-ha for having the nerve to race against her. They, he says, are heading for their destination, not rocketing all around Robin Hood's barn to find the front door."

"Th' last laugh sirrr," said McNab softly, "nicht coom fra deep i' th' belly!"

"Yes, but *whose*? Blast your officious eyes, McNab!"

"Aye, sirr! But dinna ye ken that th' rocket ship hasna reachit Pluto yet?"

"But she's approaching, about twenty times as fast as we are—for she travels nearly straight, while we gallivant off at all angles!"

AST—10

McNab shook his head. What ailed the skipper that he could not see McNab's purpose?

THE *Arachne* sped on . . . time passed. Space opened with a light-speed rush behind her—

"Now, McNab," said Parsons, "we're about right. Head for Jupiter, between the Earth and the Sun."

McNab did not move.

"Did you hear me, McNab? We're heading for Jupiter. Be ready to drive her when I've hooked onto Jupiter's lines of force!"

"Lines of foorce between Jupiter an' what, sirrr!"

Parsons' eyes bulged. He snapped a glance at McNab. Fury kept him mute for a moment. Then he exploded.

"See, you fool, what you've done? We're exactly nowhere! We can't head for Jupiter, and we're closer to the Sun now than we should be, and heading for the Earth sends us almost on our own back-track—a cockeyed zigzag—"

"Dinna ye think th' zigzag, sirrr, has its merits?"

"You mean, actually cut back, toward the Earth—while that rocket ship, unencumbered as we are by the necessity of following lines of force, approaches Pluto in a direct line?"

"Aye, sirrr, if one might suggest—"

"We make a trace-in space like a kid making henttracks with a pen on scratch paper—and we come as much nearer to Pluto as the kid would that made the tracks!"

"Aye, sirrr, but since there be naither—"

Parsons swore. McNab watched him. Then he grinned—entirely inside himself, with approval. Having no choice, Parsons was making a swing through space, to contact the Sun-Earth force lines. McNab's reasoning was elemental—and only Parsons' stubbornness kept him from realizing it. But even as

he changed course, a light flashed on the signal panel over his head. Parsons flipped a button—and into the control room of the *Arachne* came the jeering voice of the skipper of the rocket ship headed outward for Pluto.

"When you get through playing tag with yourself, Parsons, how about *trying* to give us a race for Pluto?"

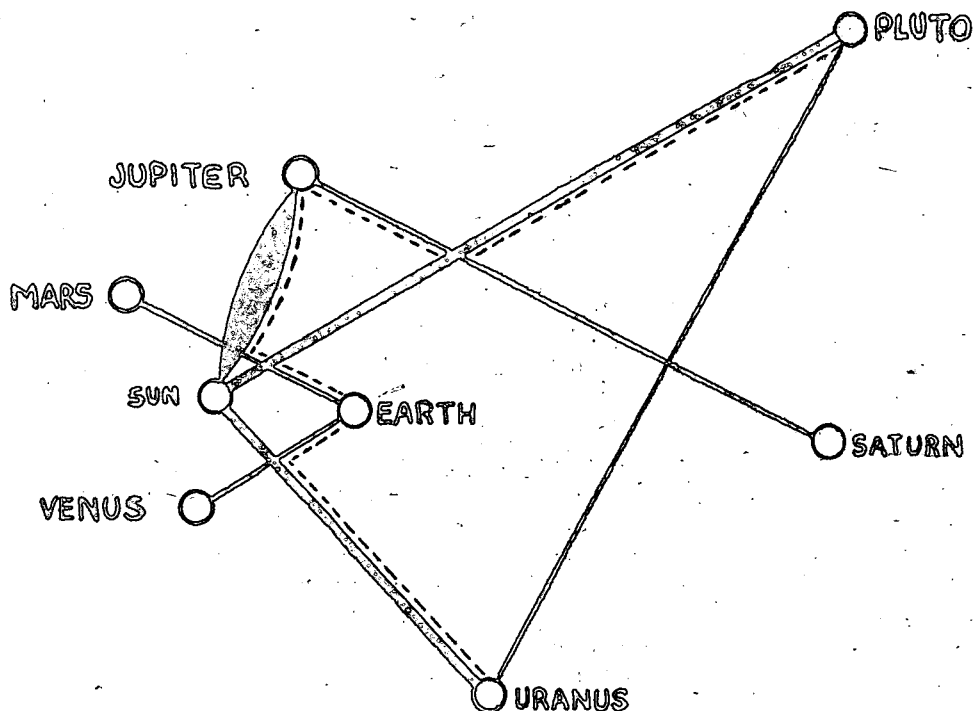
Purple with wrath, Parsons flipped the button, shutting out the hateful voice. The *Arachne*, on her new course, gathered speed again, piled it up, poured it on, and the D.C. motor revved up almost to her limit. Then Parsons, while McNab began to watch, started—rather thoughtfully—to chart the positions of the planets. McNab was sport enough not to grin when, craning his neck to see what the skipper did, he noted the result—which McNab himself had already worked out in his head, and on a chart of his own in his cabin.

McNab spoke softly. "Beggin' your pardon, sirr, but there's one thing

about the rockets that's nae so weel as they'd like. They must, by the nature o' things, discharge their rocket mass. It's ah fine they've got their powerr o' the atoms same as we—but they must throw off their rocket mass. There's a leemit, ye ken, to the speed yon rocket can make. She carries, when she starts, all the rocket mass she can have, and she throws it oot as she goes. She throws oot ah she can—an' yet ha' enough to halt her when she reaches Pluto—but there's iver that leemit. With the powerr o' the atoms, there's na leemit save only that o' the discharge mass.

"But, ye ken—we ha' na discharge mass. We canna go in the strraightes' line, we must follow the lines o' force that link the worrlds—but we ha' na feexed top speed."

Parsons looked at Josh McNab's leathery poker face and grunted. Then he looked at his position chart and narrowed his eyes. The chart looked much as McNab's had:



"PLUTO and Uranus," said Parsons speculatively, "are about as far apart as they could get. Uranus has mass, but Pluto's light. Those lines—some five billions of miles long—would be weak as a baby's breath. M times m over d squared—and d bein' damn near infinity, so far as those little m's go. But Uranus-Sun, now—with the Sun's all-mighty M multiplyin' on top of the formula—aye, we've got a cable to haul on there. Then if we shunt off on the Earth-Venus lines—and cut across close round Earth to the Mars-Earth lines, we'll pick up the heaviest lines in all the System—the Jupiter-Sun lines—to haul us out again!"

"Pickin' up speed ivry inch o' the way," said McNab.

"You've got to cross though—reach the Pluto-Sun lines—"

"Dinna fergit this *ither* planet," said McNab, stabbing a blunt finger at the chart.

"Saturn? But how? We can change to the Jupiter-Saturn lines—strong lines between the two heaviest planets—if we go down to Jupiter itself."

"The moons, mon, the moons," snorted McNab.

"Get back to your Tunnel, McNab!" roared Skipper Parsons. "When I want you to plot my course for me, I'll let you know!"

"It's your job to keep the *Arachne* going, not skipper her! And get this through your thick skull: I intended to follow this cockeyed route all along."

"Aye, sirrr!" said McNab, his eyes twinkling. He turned away, to go back to his duties as boss of the Black Gang.

"Before you go, McNab, listen while I tell off the skipper of that rocket ship!"

McNAB WAITED. Parsons spoke into the Interplanetary Communicator. McNab grinned as he watched him. Parsons was in the height of his glory.

As he talked he stood very straight. He pulled down the hem of his blouse, as McNab had seen him do a thousand times when he had strutted his stuff before admiring lady passengers. He waved his arms.

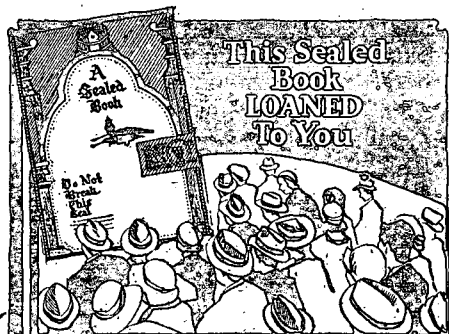
"Listen carefully, Folsom," he addressed the rocket-ship master. "I know more about routes between planets in five minutes than you'll learn all your life! You've got the fastest thing in space—but you haven't the brains to go with it! I'd like to make a bet with you, that while right now we can't seem to see you for dust, we'll beat you to Pluto. Not only that, but we'll continue to play tag with ourselves, as you suggested, and we'll snatch that Element 103 right out from under your noses! Long live Martin Caperton!"

"Th' teet-feested ole curmudgeon!" interjected McNab.

McNab pulled his forelock, his face empty of expression. How, lucky, he told himself, sarcastically, that Parsons had figured out a way to beat the rocket ship to Pluto, despite the *Arachne's* handicap of having to start from Uranus, after the rocket ship had shot from the Earth!

But, a good engineer, whatever he might think, McNab settled down to help Parsons make a race of it. It had become so real to McNab now that he could look ahead, and tell almost to the minute when, as it were, the *Arachne* and the *Comet*—the rocket ship—would be racing neck and neck for Pluto. Right now, the rocket ship was heading as nearly straight for Pluto as orbits of various planets permitted, while the *Arachne* had to shuttle back and forth through the whole blasted firmament—but at a speed that would have made the rocket ship look sick had they been racing side by side.

Anyhow, he thought, as the *Arachne* headed for Jupiter, they were edging toward the path of the rocket ship! They



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were creeping up on her. In his mind McNab estimated the time each ship would yet have to take to reach Pluto, and his heart hammered with excitement—with joy of competing in a race of centuries, of ages. Who could even hazard a guess when, if ever, two ships would have a mission like this, and find themselves at such widely separated starting points, with the planets in their orbits in relation to one another as they now just happened to be?

"Some day," thought McNab, "I'll ask th' skipper to join me in a game o' chess!"

For, at that, it *was* a chess game, with the *Arachne* and the rocket ship as the master pieces, the planets and the Sun as the pawns. A game of speed, played for stakes of stellar magnitude, against the backdrop of God's great firmament. The mites of humans in the *Arachne* and the *Comet* were almost gods at this moment, and would continue to be until the race had been run, the prize awarded.

THE *Arachne* headed for Mars, quitting the Venus-Earth lines of force, to hitch onto the Earth-Mars lines—following them until they converged with the Sun-Jupiter lines, which she followed to the very heart of Jupiter's mighty, tangled moon system. A dozen times she shifted lines till she caught the Jupiter-Saturn lines—along which she fairly screamed until there was nothing left for her to do but cut loose and head for Pluto, along the Sun-Pluto lines. But now, on these lines, the last lap, the *Arachne* was decelerating from her frightful maximum, reached as she reeled up the invisible strands of the mighty Jupiter-Saturn force-lines.

Four days out of Pluto—and some twenty-six days after the mad start from Uranus—the officers and crew of the *Arachne* let the spaceship travel her best, for a time untended, while they lined the plastic windows in the belt promenade to search the heavens for the *Comet*.

For the *Arachne* was overhauling her! McNab and the skipper were almost

fighting at the Visi panel in the control room, trying to pick up the *Comet*, which was still ahead. McNab's whole body ached, as though he were pushing the *Arachne* forward with his own bone and muscle. The lines of Parsons' face were tense with strain.

"There she is, McNab!" he said finally. "And we're going to pass her in nothing flat. Listen, man, we'll beat her to Pluto by almost two days, at this rate!"

"Aye, sirr," said McNab, quietly, "at this rate!"

Parsons whirled on the man who always baited him. "What's the matter with you? After all I've done to outsmart and overhaul the *Comet*—which we'll pass in a few seconds—are you beginning to doubt that we'll beat her, after all?"

"I dinna ken, sirr!" said Josh. "But this I do ken: we pass her, aye, but will

she pass us anon? We're decelerating, an' ha' been for half a billion miles, and will for the four days to coom. But the *Comet's* a rocket, driftin' slow now, maybe, but she'll hold that pace and do a' her slowin' in a day!"

"It'll be Hell if, after we pass her, we decelerate so much she passes us again! We'll be the laughingstock of the whole galaxy!" groaned Parsons.

"Aye, sirr. I ken thot, sirr, wherefore all th' speed I ha' bin—pardon, sirr, the speed you ha' bin—"

"If we fail, McNab," said Parsons, ominously, "after coming so close to winning, you may rest assured that I'll lay the blame where it belongs! Right on your head!"

"An' th' crrredit, sirrr?"

Parsons gasped, swallowed. Then, because he had to strut for somebody, if it were only his crew—and because to do so now made it unnecessary for him to

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give McNab an answer to his latest pointed question. Parsons spoke through the *Arachne's* address system, jubilation in his voice.

"We have passed the *Comet*, four days out of Pluto, twenty-six days out of Uranus! They have given us a good race, but they have lost. If you look closely, you will see the *Comet*. She seems to be traveling backward at top speed—"

McNAB DIDN'T even bother to look now. He was waiting to see what the skipper would do about things. The *Comet* had been passed, that's all McNab cared about. She was already a lost speck in space behind the *Arachne*. And Parsons was getting set to start bragging to, literally, the Universe, about what he had done.

Disgusted, McNab went to his cabin, and began to do some rough figuring on paper with a blunt pencil. What he discovered made him grin, even though his eyes were grave. After all, no matter who got the credit, he wanted the *Arachne* to win. And there was an excellent chance she might not.

With his figures in his fist, McNab went back to the skipper, to report that the finish of the race might well be a photo-finish—that even now, with the *Arachne*, perforce, decelerating, the *Comet* was beginning to pick up lost space.

McNab—though it might have been a mean thing to do—told the crew to keep a weather eye to the rear, and watch the *Comet* pick up on them again. The men gasped, swore—though they probably didn't understand what was happening: that the *Arachne* had passed the *Comet* at her, the *Arachne's*, top speed, while the *Comet's* speed would remain constant, and the *Arachne* was even now forced to decelerate. For the *Comet* could decelerate more rapidly—in less distance—than could the *Arachne*.

So the grim race continued. The *Arachne*, slowing down during agonizing hours of suspense, during which Parsons almost started to get gray of hair as well as of face—and snapped the head off McNab every time he opened his mouth—while the *Comet* regained lost space.

The *Comet* was just that—a comet in fact—overtaking the *Arachne*, when the helicopter tugs of Pluto came out to warp the *Arachne* in. For a wild, terrifying moment McNab thought that Parsons, mad with fear lest he lose the race at the last minute, was going to try for a landing without the tugs. That might well have been suicidal.

McNab settled that, instantly. Knowing Parsons' stubbornness, he settled it in the only way possible. He suggested that Parsons actually order the tugs to stand clear, and land without them!

"That, McNab," said Parsons savagely, "is the worst piece of advice yet! And suicidal. Naturally I won't be so foolhardy!"

"Aye, sir," said McNab, not cracking a smile.

And so, with tugs working their fastest, and Parsons throwing fits all over the control room—and wondering if, maybe, the skippers of the tugs might not be in the pay of the opposition—the *Arachne* came to rest at her Plutonian landing stage.

And, by the grace of whatever gods guided the destinies of space fliers, the *Comet* was still afar off!

"I guess, McNab," said Parsons, preening his invisible feathers, "that I showed the *Comet* a thing or two about celestial navigation!"

WHEN, long later, with the precious Element 103 aboard, the *Arachne* made the trip homeward to the Earth, McNab was almost ready to commit murder before the landing. Parsons seemed to

have just one word in his vocabulary, which he kept going constantly when McNab was around.

The word was "I"!

Caperton himself met them at the landing stage, with a group of officials about him, and a sea of faces stretching away in all directions—the faces of people come to do homage to the hero of space who had sped such a cockeyed course through the heavens to Pluto from Uranus, to beat the crack *Comet*, and bring home the bacon. Caperton made a speech of welcome, then called on Parsons for a few words.

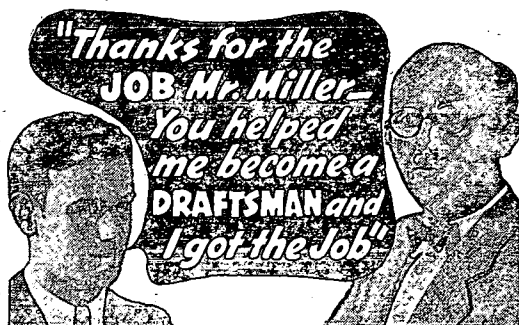
McNab ground his teeth and listened.

"I saw right away, on Uranus," said Parsons pompously, "it was useless to head directly for Pluto. Too far from Uranus, therefore connected with it by weak lines of gravitic force. So, I headed straight for the Sun, following the most powerful lines available, until I converged—"

"I . . . I . . . I . . . I . . . Never a word of credit to anyone else," thought McNab. Parsons might at least have given some credit to the Black Gang, even if he did slight McNab himself. But after all, you probably had to let a schoolboy boast a bit.

"Those lines were plenty powerful, Jupiter being 317 times the mass of the Earth—"

On and on, sickeningly, went the explanation. McNab caught snatches of it . . . "Saturn 94 times the mass of the Earth . . . Neptune 17 times



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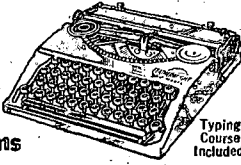
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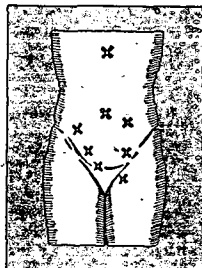
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the mass of the Earth . . . Pluto one and four tenths the mass of the Earth—”

How could he tell anyone—except, when he got the chance, Parsons himself—that Parsons had memorized the data he was spouting from a memorandum McNab had left lying on a desk in his cabin?

“I weesh,” he said to himself, as he tried, with signal lack of success, to catch the eye of Parsons and freeze him to silence with a look, “I hadna writ it doon! Thin yon skipper—th’ scut!—would be tongue-tied th’ noo!”

There was one consolation for McNab, however, in that, with every word he spoke, Parsons hung the job of a freighter captain—precious freight, maybe, but freight just the same—more tightly about his own neck. McNab had made sure of that! There was just one fly in the ointment: McNab would probably be his chief engineer to the end of time!

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Wouldn't a human infant learn to walk "instinctively" if left to itself long enough? The great apes do.

Dear Mr. Campbell:

I don't often take offense at criticism, but there are times when a man must stand up for his rights.

Although I feel flattered that Mr. de Camp noted and thought that a former letter of mine to Science Discussions warranted comment, he misconstrued the idea I was trying to put over.

Mr. de Camp took for granted that I confused *instinct* with *conditioned reflex* because I tried to illustrate that repeated actions might develop into instinct. I altogether agree with Mr. de Camp that repeated action such as a dog answering to its name, or a man's fingers automatically finding the keys after years of practice on the piano would be conditioned reflex. But my argument was: suppose that after generations of doing a certain thing at a certain time, an offspring performs that act *without* being shown how. That is instinct.

According to what is written above, and also claimed by leading scientists, human beings must learn to walk and to talk. Therefore, what might ordinarily be taken for instinct is really conditioned reflex. Ergo, it must take a very long time for a conditioned reflex to become instinct, because we know that man has been walking on his hind legs and talking for untold millenniums. But I believe that this is a borderline example, because no one teaches a baby how to crawl, and if he didn't know how to crawl, no amount of instruction could teach him how to walk. The same thing goes for talking. A mother can teach the child what sounds to make, but cannot teach him how to make it.

In order to squelch any controversy from readers concerning my last statement, let me say something in regard to any mention of schools for the born-deaf which teach their charges how to talk by manipulation of the mouth, throat, tongue and breath control.

The argument might be: if these people knew how to talk by instinct, they would not have to be taught how to form word-sounds, or rather, vowel-and-consonant-sounds. But do not forget an important factor; these unfortunate people are not infants, but are at least grown up to a reasoning age. If one stood in front of an

infant and made those faces and gestures, I can guarantee the only response would be babyish gurgles and, most likely, some very loud bawling.

It has been proven that even instinct needs some sort of stimulus to make itself manifest. The stimulus in teaching an infant speech is the hearing of a certain sound which the child tries to imitate without any instruction as to how to do it.

When a mother teaches her child how to walk, she waits until the bones in the child's legs are strong enough to hold its weight, then all she does is to hold the child by the arm somehow and half-drag him across the floor. The child *himself* moves his legs in a walking motion. Naturally, it will take some time before he will walk by himself. But in the lower animals the mother does not often teach its offspring to walk; they just get up and crawl at first by themselves, and, when they are strong enough, they walk on upright legs. A bird does not teach its fledglings to fly. The old bird just shoves its offspring out of the nest when it is strong enough, and as soon as the fledgling finds nothing solid under its feet it starts to flap its wings of its own accord. But in all cases a stimulus was needed, as was shown.

Therefore a person born deaf, or deficient in certain senses, cannot receive the stimuli necessary to bring the complementary instinct into being.

—George Trott, 1337 Grant Ave., Bronx, N. Y.

There is enough wavering in the orbits of the moons to permit the configuration shown.

Dear Sir:

I believe I have discovered an, if not *the*, inaccuracy in Astounding's third mutant cover. The Jovian moons rotate all in approximately the same plane. So, from a viewpoint on one of them, the centers of the disks of the others would be points on a straight line, which line would pass through the center of Juniper's disk, and be very nearly parallel with his equator. It is not thus with the picture. Callisto and Ganymede are in their proper places, but the blue moon (Io?) and particularly the yellow moon are to one side of the ecliptic; evidently to the north, since the red spot is in Jupiter's

southern hemisphere. As the north is to the right, the men are facing west and Jupiter is setting.

The ideas mentioned in L. S. deCamp's review of "The Origin of Life" are extremely interesting. A more complete article on that subject could set a new high for value. Can you get one for us?—Phillip Lee, Gallen, Michigan.

I'd say this thought finishes the idea that there must be intelligent Martians because we see "canals."

Dear Editor:

This new (I hope) idea has been in the back of my mind ever since I read the article on chemiculture in the August issue of Astounding. If the Martians were intelligent enough to construct the huge canals (according to present-day theories) which they made to conduct water from the melting ice caps to their land for irrigation purposes, why weren't they intelligent enough to make huge tank farms closer to the poles, heated electrically and using ultra-violet lamps for sunlight? It seems to me, that this would be both easier and more scientific. None of the water would be wasted, nor would any material used as fertilizer. It is supposed that they have to conserve as much as possible. Perhaps this theme can be elaborated by one of your authors into a story, or it may just make a new topic for Science Discussions. What are the lines on Mars, if they aren't canals?—A. Ross Kuntz, 2541 Dunsmuir Ave., Los Angeles, California

From the author of our telescopes article.

Dear Mr. Campbell:

The cover picture on the November Astounding is quite interesting. The error which you mentioned is, of course, obvious. When more than half the surface of a sphere is lighted, the terminator should be convex instead of concave.

In general, the picture is excellent, but there are some minor details which might have been improved. First, the amount of red is somewhat too noticeable. Jupiter is *not* as red as Mars. Second, the blue-white atmospheric outline would not be so very prominent to the naked eye. True, the planet may show a blue border when seen with a telescope, but the blue edge is due to chromatic aberration in the telescope, and not to atmosphere. When seen with a good telescope, the blue border is missing.

As to the surface details, there can be little criticism, as they change rapidly; in a series of photographs taken over several years, very distinct changes in the dark belts from year to year are the most striking feature. When observed visually, the colors also change. Creamy white, reddish brown, gray and black are the colors most frequently seen. Although some spots are very dark, the only real black observed on the planet is the shadow transits of the satellites.

The following, taken from my notes, gives some idea of the colors which are sometimes seen on Jupiter.

Three A. M., July 18, 1938. 'Scope, twelve inches. Seeing good. South equatorial belt reddish brown, darker in center. Northern equatorial belt brown, but without the red tint of the Southern belt. South Temperate belt sharply defined, blue-gray in color. North temperate belt broader, and less blue. Equatorial region turbulent, with numerous white spots and one small, very dark spot. Both Polar regions brighter than usual.

Please do not regard this letter as a kick at astronomical covers. I like them, and hope you will have more of them—Harold A. Lower, San Diego, California

Would the Moon's fragments reach Earth?

Dear Mr. Campbell:

In some recent astronomical reading, I've come across a prophecy of the end of the Earth that runs about as follows (the readers have probably heard this before): The gravitational pull of the Moon serves as a brake on the Earth's rotation, because of the friction involved in the sloshing of the tides around in the ocean beds. Therefore, the day will slowly lengthen until it is equal to the month (which will then be somewhat longer than it is now), and the Earth and Moon will always show each other the same face as they revolve around each other, like a couple waltzing. To conserve the angular momentum of this celestial dumbbell, the Moon will have moved farther away from the Earth than it is now. While there will still be slight solar tides in the oceans, the lunar tides will have become stationary humps of water—and also of rock and of atmosphere.

Then the much slower action of the Sun will gradually slow down the rotation of the Earth and Moon around each other. With angular velocity decreased, the centrifugal force holding them apart will be decreased. As the mutual attraction between them is not decreased, they will approach closer to their common center of rotation.

When the Moon is twelve thousand or fifteen thousand miles away, says the theory, the difference between the Earth's pull on its inside and outside faces will subject it to a tensile stress sufficient to break it into pieces. So far so good. But the theory goes on to say that the pieces from the nearer half will come showering down on the Earth, with unfortunate results to the latter's inhabitants, if any. The oceans will boil away, et cetera.

Now, that the pieces from the nearer half will come still nearer is obvious, as their angular velocity is the same as that of the farther pieces, but their radius of gyration is less, wherefore their linear velocity is less. But need they hit the Earth? I don't think so. They have only to fall about one-sixth the distance to Earth to reach a stable orbit, at which point their centrifugal and gravitational pulls will again balance. The pieces from the outside half of the Moon would fly out from the Earth about an equal amount before the same thing happened. So, if our Moon breaks up into a football-shaped cloud of fragments, with its long axis pointing at the Earth, the fragments at the inner end will gradually pull ahead of those on the outside in their race around the Earth, so our football will be pulled out into a long spiral chain of fragments, which will appear as a continuous ring by the time the inner end has lapped the outer a couple of times. We might suffer somewhat from earthquakes and tidal waves during all this, but these would be annoying rather than catastrophic, especially as the breaking-up process should take months rather than minutes, and, if the month-day at that time is about sixty of our present days, the time required for the inner end of the string of fragments to lap the outer should be on the order of four of our present months. (The inner end of the string might be about two-thirds as far from the Earth as the outer end. In that case, the ratio of the time required for the outmost piece to circle the Earth once to that required for the inmost piece to do likewise works out to $\sqrt{28/3}$, since the length of the time of rotation of a satellite about its primary varies directly as the one-and-a-halfth power of the radius.)

So I doubt whether the fall of the Moon is much to worry about, especially as the retardation of the Earth's axial rotation is probably not more than .001 second per century, and as, by the time this happens, man may know enough about such things to take the Moon out into space and throw it away if it shows signs of becoming a nuisance. Any comments?—L. Sprague de Camp, 44 East Sixty-third Street, New York City

BRASS TACKS

To the Readers of Astounding Science-Fiction:

Because of the tremendous interest that has been aroused in the WORLD SCIENCE-FICTION CONVENTION, Mr. Campbell, editor of *Astounding*, has asked me, as one of the leaders of *New Fandom*, to write a brief account of this great project.

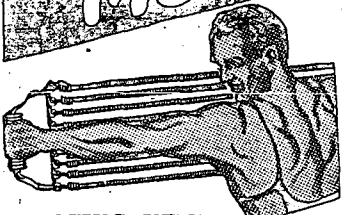
The World Science-Fiction Convention will be a gathering of science-fiction fans and readers from all over the world. This great get-together will take place in the early summer of 1939, at the height of the New York World's Fair. Plans for this affair are now being rapidly whipped into shape by *New Fandom*, which is an association of all science-fiction readers who want to see science-fiction advanced.

The convention will probably last three days. On the first day, members of *New Fandom* will meet. This will be a purely business meeting for members only, during which the status of *New Fandom* for the past year will be discussed and future plans outlined. The second day will be set aside for a meeting of all science-fiction-readers who are amateur scientists. The scope of this meeting will be technically scientific. Prominent scientists and engineers will be invited to attend and to give their views of science-fiction. The third, and by far the largest, gathering will convene on the third day, the day of the convention proper. This meeting will be thrown open to the science-fiction fan, the science-fiction reader, and the general public. The editors and official representatives of every science-fiction and fantasy magazine will be present to address the large audience. Popular scientific lecturers and educators will be there to help insure a really fascinating program. *New Fandom* hopes to obtain the great scientific film "Metropolis" to be shown at this meeting. In any case, there will be at least one well-known scientific film shown. The five-reel, unabridged film version of "Einstein's Theory of Relativity" will also be given, as well as other films of science-fictional interest. There will be speeches by well-known authors and prominent science-fiction fans, and several unique skits and playlets will be presented by the various regional fan organizations.

On the evening of this red letter day, a dinner will be given in honor of some science-fiction professional artist, author or editor, who in the opinion of *New Fandom*, is deserving of special credit for his work in advancing science-fiction.

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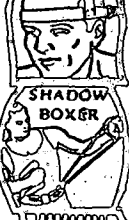


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I hope that this outline of the World Science-Fiction Convention will start you, the readers of *Astounding*, on the way to making preparations for coming to New York to attend the convention. Space is insufficient to tell all about our plans and hopes for making this thing the great success it deserves to be. If you really think this is a great idea, then communicate with me at once so that I will know how many to expect, and so that I can explain the idea behind the convention to you more fully—William S. Sykora, *New Fandom's* Convention Committee, 31-51 41st Street, Long Island City, New York.

Even if he didn't like us, we'd like a letter like this. He's invited to return.

Dear Mr. Campbell:

This is some sort of a record, being only the second time I have ever written to any magazine. However, I cannot resist that impulse. So here goes on my private Analytical Laboratory for the November issue. From cover to cover I read it, and thus it is only right that I start to comment with the cover. By the way, my chatter-machine is perched on my lap, so please overlook any errors.

Now I am no expert on science-fiction, having had but four copies' experience, but it may help you to determine the average reader better than an old hand at the game. The cover is O. K., but nothing spectacular. Personally, I prefer drawings of imaginary equipment and technical materials.

"Simultaneous Worlds" I rate three out of a possible five plums. (They've used bells and stars, so I'll use plums.) It is a mite confusing. I'll have to read it a couple times more yet before I blast the theory into my inert brain. The idea is good, but—

"Return of the Prowler"—four plums. Very neat. Perhaps being the proud (?) owner of six (6) cats, I am somewhat partial to cats in stories, and therefore no judge, but it is still four plums. (By the way, "Double! Double!" in a recent issue also took my fancy to the tune of four plums.) There is one bone to pick with Hon. Mr. Vincent: Are you insinuating that Miracle is the only cat that can think? Come see me, and I'll show you six of them. True, they can't communicate with us, but they *do* think! That's not as remarkable as you would have us believe.

Now we come to "The Tramp." Also four plums. The first and third parts were almost five, but the second, even with the beautiful description of Doughface trying to drive the taxi, brought the story as a whole down to four. I like this kind of a story as a change from the poor, exhausted space-travel and super-machinery type.

"Reunion on Ganymede"—three plums. Humor very well played and placed. The old plot, even with a new twist, of a united universe and space-travel seems mild. Cliff deserves credit for the style of writing, though. Put him on a plot he can get his teeth into, and watch him! Malcolm Jameson's "Seaward" gets two plums. Once in a while I feel kittenish—ready to claw someone. This story gives me a tinge of that desire. I don't say the story isn't good; it just rubs my fur the wrong way. Sometimes I even feel like eating one of those plums.

Now this next one. Pray, dear friends, what has it got to do with science? This may deal with the Fourth Dimension—to which I am quite partial—but trying to ring baseball into time-travel seems too much, even for me. Put this gem into *Sport Stories* where it belongs. Give it one—prune!

"The Forgiveness of Tenuhu Taen" certainly is a beautiful description of Mars. (I've never been there, but it's still a good description.) The story is sweet—like honey—and slightly sticky. But it gets two plums.

Aha! What have we here? Not—not—yes! A five-plum story! "The Silver Sphere" is surely the outstanding bit of the issue. The plot is an original twist of an old theme, and the carrying out is excellent. I particularly like the idea of atomic travel. I don't know why. Anyway, this is my favorite story. Even the illustration is good. Wesso is my pick, anyway. Notice his drawings for "Simultaneous Worlds" in particular. If you like them rated in order, here they are:

1. "The Silver Sphere"—Heckman—5 plums
2. "Return of the Prowler"—Vincent—4 plums
3. "The Tramp"—Hubbard—4 plums
4. "Simultaneous Worlds"—Schachner—3 (or 3½) plums
5. "Who Was Dilmo Deni?"—Rocklynn—2 plums
6. "The Forgiveness of Tenuhu Taen"—Kummer—2 plums.

I left out "Reunion on Ganymede," so that really is No. 5; No. 5 is No. 6; and No. 6 is No. 7. You get me?

8. "Seaward"—Jameson—2 plums—or 1½ is better
9. "The Einstein Inshoot"—Bond—1 plum.

Shouldn't even place, but I'll take pity on it. Now I've had my say, so I'll leave it up to you. I don't bother with the articles (except DeCamp's "Language for Time Travelers")—so we'll just forget this. Keep Wesso behind the pen, and Heckman and Schachner behind the typewriters, and you'll do all right.

If this is any help, I am a typewriter mechanic (expert), twenty years old. There you are—Gerald B. Clarke, 212 Main Street, Waterville, Maine

Survival of the fittest.

Dear Mr. Campbell:

It has been almost six months since you have received a letter from me, but I couldn't resist the temptation any longer. There is no especial reason for this change of policy on my part; I just wanted to write a letter again.

Your Analytical Laboratory might be a good idea, but I have always found it hard to classify the stories in any issue of a magazine according to worth. Some of them cannot be compared, and what do you do in a case like that? Personal preferences, for me, is something which is singularly ill-defined, and the impressions that I get from stories widely divergent in every quality are sometimes exactly the same—usually of the nauseous kind. But, there is one way that has worked with a little success with me: the process of elimination. I can easily pick out the stories that *weren't* the best in the issue, and the one that is left at the end, is it. So here goes:

It certainly wasn't the "Silver Sphere." My opinion of that was "pot-boiler." It was not the Dilmo Deni thing; that was more pot-boiling to me. I must also eliminate "Reunion on Ganymede," although it did have something. There was a bit of straining in its writing. Also eliminated is "The Einstein Inshoot." This I do with some trepidation, as I know that this was one of the so-called "mutant" stories. But it seemed too trivial—like something I wrote. Bond is a good, competent hack, but he should stick to straight sports, or pick a bigger theme. A story that can be discussed with a "so what?" is not liable to stick with the reader. "Return of the Prowler" goes next, not that it wasn't good, but that it wasn't as good as the original story. It was a letdown, and that sinks it. About the only sequel I have read that surpassed the original story was the "Son of Old Faithful," and that series, disregarding the last story (which was horrible) was the best that you ever printed. That leaves "Seaward" and "Forgiveness of Tenuhu Taen" vying for the

honors. Of the two, "Seaward" is more like the usual run of stuff, so I'll discard that one, leaving "The Forgiveness of Tenuhu Taen" at the top. Its peculiar human (or Martian) interest is the thing that no doubt raises it above the others, and Kummer should stick to this type of story for awhile.

You notice that I have left out the serials. It is absurd to pass judgment on one installment of a serial! I haven't read any part of either of them yet, but I will read "The Tramp" sometime. It looks pretty good. I am not in favor of serials—rather the long stories should be published in a quarterly (that's here again) or an annual, for that matter, or run the whole thing as a "book-length novel," or something. You ruin a story, as far as the desire to read it is concerned, when you run it serially.

The cover was good, about the best of the mutants so far. But would the shadowed half of Jupiter be as small as represented? I should imagine it as being almost half of the planet. The reflection of Jupiter-light on the surface of Ganymede is superb. And Brown's illustration inside was the best in the issue! I don't know where people got their objection to Brown inside. He's the best artist you have. Dold and Wesso are good, but they can't hold a candle to Brown. And can that Orban, will you? I never did like his work. Schneeman is getting worse, and Thompson never was any good—Raymond van Houten, 26 Seeley St., Paterson, N. J.

"School days, school days, dear old—"

Dear Mr. Campbell:

To give a more or less complete review of the November issue, as per your standing offer. Grades range A to F. A superlative, F, flunk.

"Silver Sphere." B—. Too much like Hamilton's old Antares stories. Fairly well written, though.

"Seaward." B. Isn't he a little light-hearted with his slaughter?

"Return of the Prowler." B. Well written, but a little too far over toward the fantasy end, perhaps. Still, I dunno.

"Who Was D D?" A—. Swell. Most bust a gut!

"The Einstein Inshoot." A—. Ditto.

"The Forgiveness of Tenuhu Taen." C. Mediocre because it was not science-fiction by any stretch of the imagination.

"The Tramp." A—. Holds up to the end. Hubbard did a good job.

"Sim. Worlds." (?) Haven't read it yet.

Article. (?) Ditto—but I don't get excited over articles, usually.

"Reunion on G." A—. Good stuff—first time it's been applied to science-fiction—the reunion idea. But why did Gramps have to talk like a hick veteran of 1865? That was a weak point. The Senator was very good, and his damned camera.

Have a reference you may be able to use in a story or article. Chem Abstracts 32, 4874, (1938) Age of Sun calculated by Actino-Uranium ratios. Method not explained in abstract, but result is 4.5×10^9 years. Reference is to a German or Austrian journal—you can find the Abstracts and that journal in the Library. It's Sitzber. Akad. Wiss. Wien. Math-naturw. Klasse, Abt. IIa, 146, 581-8, (1937). Aren't German abbreviations wonderful? You may be able to get something out of it—John D. Clark, 3809 Spruce St., Philadelphia, Pa.

E. E. Smith is working on one now; he has told me. But we know he's a slow, careful worker.

Dear Editor:

Before me on my desk there lies the September and October issues of our magazine. They are two exceptionally fine numbers. The cover for

the October issue is superb, but I have yet to see the cover that will excel the July 1937 cover of Astounding Stories.

As for the stories: "The Tramp" was quite good. "The Trapper" was excellent, and "Robots Return" was a splendid short story. "Sunworld of Soldus" was an exceptional story much different from the usual trend. "Other Tracks"—excellent. "Hunger Death" was superb.

You certainly have obtained a fine staff of illustrators, Wesso leading the bunch. Brown on the cover is invincible. When are you going to obtain another story by E. E. Smith for us, and how about contributing yourself?—A. Foschetti, Greenock, Scotland

"A Matter of Form" should please you for length. And Don A. Stuart has a long one coming in March.

Dear Mr. Campbell:

My two dollars for a year's subscription is in this envelope.

I understand it is in order to give my list of stories for the Analytical Laboratory, so here you are. They are in this order: "Other Tracks," "The Command," "Hunger Death," "The Ceres Affair," and "The Magician of Dream Valley." I put the story "The Command" second because it is such a fine example of a story that is real and natural and that does not seem stilted in the least particular. I have noticed in reading some past issues of your (or rather our) magazine that the stories that are most liked are those which have a human interest in them and have a good scientific basis that is neither neglected nor overdone. For instance, just off-hand I would mention these stories: "Rebirth," by McClary; "A Scandal in the Fourth Dimension," and "The Spacehounds of IPC." The first was a fine story because it was so real and because the science in it was twisted just the way it seemed to me such a thing would happen. The second was nothing but outrageously funny. The third is characteristic of E. E. Smith in its scope and grandeur, its plausibility, and the excellent way the human side of it was written. All of his stories are like this, and copies of his first epic are collectors' items.

Another thing I would like to mention is this. I believe there are a number of readers who would like to see a few longer stories in each issue. Not long ago you published such stories under the heading "Novels," and some of your best stories were in this class. Some novels by your better authors as chosen in the Analytical Laboratory would go very fine in the magazine. Many of us get interested in a story only to have it ended before we have fairly got into it.

I suppose that if Dr. Smith keeps to the schedule he seems to have been following, there won't be another long story by him until next year; but others are, and I know I am, looking forward to it and hope to see it on the pages of Astounding as soon as possible. In this issue one of the correspondents asks for a sequel to "Seeker of Tomorrow"; I think this is a most excellent idea and I fervently second the motion.

I notice that this year the magazine seems to be changing, whether for the better or worse I don't know, but I hope better. The stories seemed to have changed with the advent of you as editor. The new type—it is hard to define them exactly—are good; but I would like to see a few of the older kind again, perhaps one or two in each issue. "Other Tracks," in this issue seems to be a good one of these, although not strictly in that class. (Notice I placed it first in my list.)

Before I close I would like to say a good word for two sections: the Analytical Laboratory and the Editor's Page. The page you write has been of interest to me ever since it was started, and it is the place to which I turn to first. May it prosper!—Melvin Merritt, Jr., 3017 NE Twenty-eight Ave., Portland, Oregon

You want Astounding more often, and me to take a holiday, eh? Now tell me how!

Dear Mr. Campbell:

It would seem as though the persistent yapping in some quarters for a science-fiction quarterly has brought results. Only, I think you got those readers wrong. They didn't mean that Astounding Stories ought to change into a quarterly—they want a monthly magazine as well. So do all the rest of us, who, regardless of our attitude toward a quarterly, would like to be able to buy Astounding at intervals of not more than a month.

Editorially, Astounding keeps improving. But we'd rather get our suspense in the stories themselves than by waiting at a newsstand with a pair of dimes that just might get spent for something else if they burn our hands long enough.

As for stories and articles, you're doing swell. Keep hounding Dr. E. E. Smith. Take a busman's holiday, yourself, and give us another " Mightiest Machine," and yet another. And don't stop looking for someone who can write the Weinbaum way. Meanwhile, cherish Williamson and Gallun, two authors who keep this reader, at least, coming back for more.—Francis Gerton, 2619 Terminal St., Philadelphia, Pa.

"Einstein Inshoot"—some liked it a lot, some—

Dear Editor:

Many beautiful orchids to you on the best issue of the year. The November number really had what it takes. Cover—splendid. Illustrations—good. Titles—swell. Plots—on the whole quite well presented (except possibly that of "Reunion on Ganymede" by Simak). Such stories as "The Forgiveness of Tenchu Taen" and "Who Was Dildo Deni?" are always enjoyable. "The Einstein Inshoot" was about as terrible as any story could be, but I'm sure the author meant well, anyway.

I actually get more fun out of "Brass Tacks" than I do out of some stories. Several letters have definite thought behind them and are a credit to their writers. I was slightly amazed to see a letter from a girl printed, but upon looking it over I realized its purpose.

Of course, Astounding has improved immeasurably since the first issue I ever read, which was way back in 1934. However, I still miss such great thought variants as: "Before Earth Came," and "Sidewise in Time." Surely there are authors who can write tales like those. Now for a quick review of the November issue:

"Reunion on Ganymede"—mildly interesting with a rather weak plot.

"The Silver Sphere"—Good reading. A sequel would be just the thing.

"Return of the Prowler"—Best story of the issue. More about this phenomenal animal.

"Seaward"—Mighty good work on the part of Mr. Jameson. His humor was a little overdrawn in one or two places, but—nobody's perfect.

"Einstein Inshoot"—Phooey.

"Who Was Dildo Deni?"—Really different and quite fanciful. More by same author.

"Forgiveness of Tenchu Taen"—Fine plot and absolutely wonderful description of a nonexistent place.

"Simultaneous Worlds"—As yet an unknown quantity, but it promises to be good.

"The Tramp"—Can't quite make up my mind. Some parts were exciting and others a little vague. Nicely concluded, though.

"When Dead Frogs Kick"—A science class in miniature. Very instructive and noteworthy.

Editor's Page—O. K. with a capital O.

Analytical Lab—Good idea, and a good way to keep up with the readers.

In closing, I only want to express my gratitude to the magazine in general which entertains

me every fourth Friday of each month. See you next month—Bill Brooks, Deveau School, Niagara Falls, N. Y.

A somewhat hesitant error-spotter, but he's quite right.

Dear Mr. Campbell:

I've just finished reading "Reunion on Gany-mede," and I don't quite know what to make of it. For months now, Clifford Simak has strained to be droll; when I started the "Reunion" tale, it appeared as though it was the same thing all over again. But "Gramp" turned out to be the humorous character that Clifford D. was striving for. The reader in the next column may think differently—say that the whole story was childish. Perhaps it was, but I liked it.

It would be dramatic to stop at this point, but unfortunately, a slight discrepancy confronts the reader, when he has read the last line of the story. What happened to the escaped convict?

I shall not write about the covers any more. They have reached the point where they are almost photographic. Expect to hear from me only when they start slipping.

Speaking of the cover error which you hinted—that's an unusually peculiar shadow being cast across Jupiter. Surely it doesn't originate from the small satellite above it!

"The Einstein Inshoot" had no scientific explanation, but was pleasing. Which brings us to the question now impending: "Should the stories have a scientific denouement, or leave the mysteries of nature unexplained?" if the former, then this novelette is in the wrong magazine; if the latter, you better drop the name: Astounding Science-Fiction. As far as I'm concerned, I read the stories for pleasure; others prefer technical dissertations. My favorite type is that in which forces beyond Man's poor power to understand act as the theme's impulse.

There has been a great lapse of time since a scientific motion picture was made. Few persons have the ability to appreciate such a trend in cinema entertainment, so it might seem we shall never really conquer the screen. Yet, I'm looking forward, ever expectant. One day we shall see the hostile void, the flaming stars, mighty procession of planets, through the magic of the technicolor camera, and the clever carpenter. Hollywood alone can bring to us what we ourselves cannot reach. Why, I wonder, is so magnificent a field left virgin? Isn't there some producer with an imagination, with a soul? Would that such a man should accidentally happen on these words and act on them. Just stop for a moment and think of it; what a spectacle!

Objectors might argue that the audience for such a picture would not be large enough. Well, only last month, a radio program based on "War of the Worlds" proved startling enough to make headlines across the entire country. "An invasion from Mars" was the cry that went up, almost as though a million people had, that moment, completed a science-fiction tale and now were seeing it come to life. It should seem, therefore, that a bit of publicity is all that is necessary to make the world science-fiction conscious.

This is quite the longest letter I have ever written to Brass Tacks, so—I delegate my "crusade" to the Worlds of If, and pray somebody is in accord—Gerry Turner, Ohio State University, Columbus, Ohio

That extension to interlocked "egos" is just what Schachner was working up to!

Editor, Astounding Science-Fiction:

The November issue of Astounding is excellent! A graph of the relative merit of the past five issues would look like Sawtooth Range—with this issue high on an upward curve.

I see Time isn't the only magazine that is eliminating the "spinach" and outdated folders. Look at that new contents page! And we are promised a new cover make-up for next month. Am I mistaken, or are you trying to sneak in a better grade of paper? All the changes, so far, are to the good.

We like the cover! In fact I'll go so far as to say it is one of the best I've seen. The



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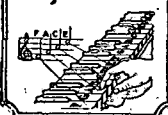
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composition of Wesso's cover for "Hell Ship" was good, but I don't care for his choice of colors. In the correct illumination *this* cover does look as though it were fluorescent, just as you say it should.

The stories: Top honors to "Simultaneous Worlds." I give it first place, not because of the story structure, but because of the "new concept." Who is this Nat Schachner? Where does he get his ideas? He has come so near the truth, on occasions, that I am sure he must be more than the "story mill" he at times appears to be. For the purposes of his story, he has assumed that a certain type of wave-train connection exists, and with this premise granted, I am intensely interested in his version of the matter. May I offer another version? Wherein the matter-train extension is more tenuous, and with the addition of an extension of the ego, of the thought-processes within the brain. (Take it or leave it.)

"Miracle," the Prowler, is an intriguing character. This story could well have been longer. The conclusion of "The Tramp" held up well to the standard of the first part. A good story. "Reunion on Ganymede" and "Seaward" were fair entertainment. The Dilmo Deni story and "The Silver Sphere" were both suspenseful, interesting tales. "The Einstein Inshoot" was a remarkable little story, both in concept and style. And the science article was well presented and informative.

You asked for comments on "The Forgiveness of Tachiu Taen." Herewith my reaction: Have I not read a dozen or more stories with a similar locale, characters and action? The others were set in Shanghai, in Cairo, in Bagdad, in Singapore. Even the characters are easily recognized. The action of this story could as well have occurred in any one of these Earthly cities. There was little need to go all the way to Mars. However, I enjoyed the story, because the change from science to a bit of well-written oriental adventure was refreshing. Not too many of these—rather, give us an occasional "Bright Illusion."

The reason for so many stories high in the list (above No. 5) is that there were no poor stories in this time.

Now, maybe I'm sticking my neck out, but I'm going to put my two cents' worth into the Love Interest controversy in Brass Tacks. I won't comment on the subject in general, because I'm not qualified to do so, but I will say that I enjoyed the hearty and wholesome man-and-wife companionship of Dick Seaton and Dorothy—the elfin, half-impudent, half-sacred courtship of Larry and Lakla—the restrained love-interest in "Triplanetary" and "Space-hounds." I like the way Dr. Smith introduces the subject, and, although a "darn female" was written into "Galactic Patrol," in the person of the triply qualified Head Nurse MacDougall, the busy Kimball Kinnison left her and everyone else "out in the cold." By the way, if any story was ever "cut off at the pockets" it was "Galactic Patrol." When and if we get a sequel to it, we will watch with interest how this subject is developed.

Until next issue—L. M. Jensen, Box 35, Cowley, Wyoming.

The readers seem to remember stories too well to make reprints desirable to the majority. Jack Williamson lives in New Mexico.

Dear Mr. Campbell:

I had resolved most firmly to write no more of these deplorable fan letters, but the cover of

the October Astounding shears through my good resolution like one of the potent rays which wreak such terrible but fictional havoc during their occasional—but not too frequent, thank goodness!—appearances in the pages of the one and only magazine. And, not being of that enviable order of intellect which toys easily with fearsome figures and formulae, my literary (?) efforts must be confined to the brassiest and tackiest of Brass Tacks.

Brown has been panned mercilessly by Brass Tackers at one time or another, but old H. V. B. still remains the supreme favorite, speaking personally, and the October cover is in his best style; and (let me whisper it as befits one who finds himself in a very small minority) I like most of his story illustrations, too! Thomson's cover on the September issue was very disappointing, considering his previous good work in the magazine, but "thumbs down" will not be signaled until C. R. T. has had another chance to redeem himself. It's about time, too, that you gave Elliot Dold a chance on the covers.

Turning to the inside of the magazine, aren't you ever going to bring Frank R. Paul back to Astounding? Most of Wesso's work during the last year or so has been much below his former standard, though he and Dold, with hands tied behind their backs, can wallop the pants off Flatos, Marchioni and company. Jack Binder is the one bright star in the "galaxy" of new artists you have inflicted on us in the past.

Requests for quarterlies, companion magazines, et cetera, still keep trickling in, but I would much rather have a semimonthly Astounding. This would cut down those tense weeks we spend waiting for the current serial to be completed. A semimonthly magazine might even result in a *Reprint Department* being established! You could draw not only on Clayton Astoundings for reprints, but also on old editions of other science-fiction magazines and some of the almost legendary stories from Argosy magazine. With the exception of S. & S. Astoundings, I am disposing of my collection of magazines in the hope of making my home in the U. S. A. or Canada some day, and it would be comforting to know that many outstanding stories of the past would appear in future Astoundings. Pure selfishness, you see!

Those very few fans with enough room for complete collections of fantasy publications will, no doubt, howl with fury at the mere suggestion of reprints, but I should like to point out that the reprint department is sometimes one of the most popular features in a magazine. I'll wager that Paul Ernst's "Raid on the Termites," mentioned by Frank Alford, Jr., in the October Brass Tacks, Clifford D. Simak's "Hellhounds of the Cosmos," Doc Smith's "Skylark" yarns, et cetera, would meet with ninety percent approval from present-day readers.

Anyway, I guess I've plagued you enough for the present, though I should like to know in which State Jack Williamson lives. You say New Mexico, while a correspondent in another magazine inferred that he lives in Kansas, if my memory isn't playing tricks. And speaking of New Mexico, I don't recollect seeing any letters in Brass Tacks from addresses in this State. Are the tough hombres of the Southwest immune to the delights of fantascience?

Say, I've just noticed that I forgot to mention the stories! Still, it makes a good excuse to write again in a few weeks' time.

"And now," said he, placing a sample bag on the editor's desk, and taking out a miniature "zone of force," "I have a new line to show you. What? Not today! Very well, then. Good day to you, sir." T. Moulton, 11 Aylesbury Ave., South Shore, Blackpool, Lancs., England

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